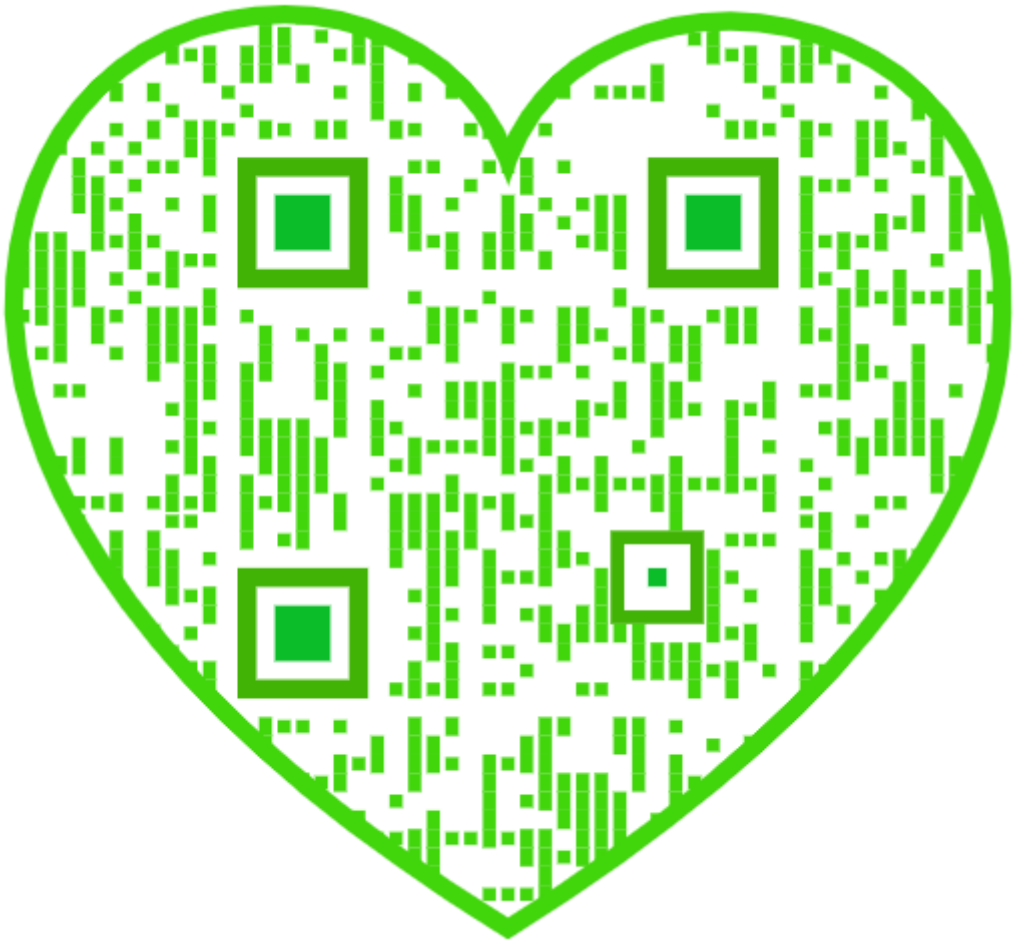

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KEY TO PRONUNCIATION.

ä	far, father
ā	fate, hate
a or ă	at, fat
ã	air, care
ạ	ado, sofa
â	all, fall
ch	choose, church
ē	eel, we
e or ĕ	bed, end
ė	her, over: also Fr. *e*, as in *de*; *eu*, as in *neuf*; and *oeu*, as in *boeuf, coeur*; Ger. *ö* (or *oe*), as in *ökonomie*.
ẹ	befall, elope
ĕ	agent, trident
ff	off, trough
g	gas, get
gw	anguish, guava
h	hat, hot
h or H	Ger. *ch*, as in *nicht, wacht*
hw	what
ī	file, ice
i or ĭ	him, it
ị	between e and i, mostly in Oriental final syllables, as, Ferid-ud-din
j	gem, genius
kw	quaint, quite
ṅ	Fr. nasal *m* or *n*, as in *embonpoint, Jean, temps*
ñ	Span. *ñ*, as in *cañon* (căn'yŏn), *piñon* (pēn'yŏn)
ng	mingle, singing
nk	bank, ink
ō	no, open
o or ŏ	not, on
ô	corn, nor
ȯ	atom, symbol
o͝o	book, look
oi	oil, soil; also Ger. *eu*, as in *beutel*
ö or oo	fool, rule
ou or ow	allow, bowsprit
s	satisfy, sauce
sh	show, sure
th	thick, thin
t͟h	father, thither
ū	mute, use
u or ŭ	but, us
u͝	pull, put
ü	between u and e, as in Fr. *sur*, Ger. *Müller*
v	of, very
y	(consonantal) yes, young
z	pleasant, rose
zh	azure, pleasure
′(prime), ″(secondary)	accents, to indicate syllabic stress

THE ENCYCLOPEDIA AMERICANA

A

ANNUITY, a yearly payment of money to a specified person or persons, for a term of years, for life or perpetually. The varieties and combinations of annuity payments are almost as numerous as the contingencies or desiderata of human life; each having figured so largely in law as to receive a specific legal title. If the annuity is for a definite term of years, it is called an annuity certain; if forever, continuing to heirs or specified successors, a perpetual annuity or perpetuity; if for a limited period, a term annuity; if during the whole of a given period, not cut short by any contingent event, a whole-term annuity; if for a short period, a short-term annuity; if it does not begin till after a certain date, a deferred annuity; if not till after the occurrence of some specified event, a contingent annuity; if its beginning or duration is based on the continuance of a life or lives, it is called a life annuity; if for the time that certain persons survive, a temporary life annuity; if on any life provided another is living, or some event happen or not, a contingent life annuity; if it begin only after some death or deaths, a reversionary annuity; if for the duration of the longest of two or more lives, a joint-life annuity; if to the survivor of two or more, a survivorship annuity. There are increasing and decreasing annuities, their nature obvious from their titles. An annuity ceasing only with the death of the annuitant, and with a proportionate part of the next payment made to the heirs, is called a complete annuity; if it ceases with the last payment made to the living, a curtate annuity. This by no means exhausts the forms or combinations possible or even actual; nor does it fully define even those mentioned. Thus, in a joint-life annuity, what is to happen on the successive deaths up to the last? The shares of the dead might return to the estate, but in practice are successively added to those of the survivors in equal portions till the last survivor receives the whole. In contingent annuities the commonest contingency which terminates it is that the annuitant shall become self-supporting, as on marriage or remarriage or the attaining of majority; as when a man provides for his widow or daughter or son by will.

In respect of object, annuities may be broadly divided into two sorts: those providing for others and those providing for one's self. The former are probably the oldest, and are of course testamentary, taking the place of a legacy in the lump. Till modern times these were chiefly (and with great European houses are still so) charged directly on the private property of the testator in the hands of legatees or trustees. In Europe these permanent charges on property form a feature of the highest social and even political importance. The entailed estates are always incumbered with multitudes of annuities to connections or dependents of the houses, absolutely fixed, while the income from which they are to be paid may shrink indefinitely. But for a century and a half it has been gradually taken up by great incorporated companies and combined with the business of life insurance (q.v.). The insurance companies pay the annuities on contracts matured by the death of the testator, the payments beginning either then or at a specified time thereafter. In America this system has also absorbed almost entirely the old contractual annuities, in which the annuitants buy incomes for themselves by paying a lump sum to a person, company or public body for a term or life.

These contractual annuities, though based on the same calculations and mathematically identical, are historically of two distinct kinds as respects their object, the one seeking security, the other investment. The latter is the older, and resulted from conditions now obsolete; partly the paucity of investment securities, partly the laws against usury, which could be evaded by annuities, as a given sum was paid for by a return of services, and the element of interest did not formally enter into it at all. Hence the favorite method of borrowing money by the great mediæval companies and houses, and municipalities and States as well, was by annuities, sold on a rough estimate of the chances of life; in which the buyers were always keener than the sellers, and till very modern times the bargain was always against the payers of the annuity. Many shrewd investors accumulated great properties by careful selection of annuities on good lives, being allowed to propose the lives upon whose duration they laid this wager (until scientific mortality tables were constructed). The interest on government debts is a perpetual annuity; and of course any investment at interest is an annuity for its term, but such investments are not

classed among annuities as the term is currently used.

The other object, that of securing one's self against the chances of fortune, though reached by the same means, has till recently had one broad distinction,—it was done at once and usually in early life, instead of in small lots as money accumulated. It was commonly the sinking of an inherited property (rarely an acquired one), by women, or by men of quiet tastes and unsuited for the struggle of business life, to produce a sure moderate income free from care and business chances. Naturally such annuities are much commoner in the older countries than in America, though steadily growing here from the same causes. Large inherited fortunes are rare in new countries, and the desire to live in unventuring ease equally so, but as family properties increase and the struggle for life grows harder, the annuity system grows likewise. But it has been vastly extended in recent years by its junction with the insurance system, enabling even relatively poor men to buy an income for their dependents after death, or themselves in old age, in small instalments instead of an impossible lump sum; and also leaving to a widow a steady income for a term of years or life, in place of a lump sum to be invested by herself or trustees, and possibly mismanaged or lost or embezzled. Therefore, both in its ease of purchase and in its advantages of payment, it is steadily growing in favor, and becoming larger in proportion to the total of life-insurance dealings.

Historically, annuities are probably as old as the great Assyrian-Babylonian times, in the 7th and 6th centuries before Christ, when great banking houses that lasted for generations, and commercial and mercantile facilities, were well developed; but the first positive mention is brought out by the Falcidian Law of Rome, 40 B.C., which enacted that not more than three-fourths of a property should be willed away in specific legacies. As this could not be obeyed unless some method of valuing annuity legacies was devised, the following rough estimate was accepted: Up to 30, 30 years more of life; up to 60, as many as were wanting to make up 60. This extremely defective calculation—which assumed that a life over 60 was not worth even a year's purchase, and was very inaccurate for others—was replaced by the great Roman jurist Ulpian (d. 228 A.D.) with one much better, though still imperfect; but interesting as the first known table of life probabilities graduated with reference to age, and, strangely enough, revived and used by the Tuscan government in the early 19th century, long after more scientific ones were in use. It is as follows:

Birth	to 20,	30 years	44	to 45,	15 years
20	to 28,	27 "	45	to 46,	14 "
25	to 30,	25 "	46	to 47,	13 "
30	to 35,	22 "	47	to 48,	12 "
35	to 40,	20 "	48	to 49,	11 "
40	to 41,	19 "	49	to 50,	10 "
41	to 42,	18 "	50	to 55,	9 "
42	to 43,	17 "	55	to 60,	7 "
43	to 44,	16 "	60	and up,	5 "

This contained no interest computation. Until the 18th century there was little advance in the scientific aspects of the business; it remained a speculation, though an extensive and recognized one, and England under William of Orange may almost be said to have maintained her national existence by borrowing money on annuities, as the Dutch had to some extent before it. The researches of Pascal, Fermat and Huygens in the 17th century into the theory of probabilities greatly advanced the accuracy of calculations; in 1742 Mr. Thomas Simpson published his 'Doctrine of Annuities and Reversions,' one of the landmarks of the business; and in 1762 the Equitable Assurance Society, the first insurance company of the world, was started primarily to do annuity business, which is the parent of life insurance, though now but a minor incident in it. Several other companies were founded shortly after. The real foundation of modern life insurance, however, and of scientific annuities as well, was the publication in 1771, by Richard Price, of his Northampton Table of Mortality. This estimated the term of life-average too low, but it was the predecessor of the Carlisle and other tables on which modern life insurance is built, now supplanted by the actual experience for generations in numberless great offices.

It is obvious that while the rate of mortality is a determining factor in annuity rates as much as insurance rates, its incidence is exactly in reverse. That is, the higher the rate of mortality and the shorter the average term of life, the less money in gross will have to be paid on a contingent annuity contract, and consequently the less will be the sum needed to sink in it, or in current phrase, the lower the rate of annual premium. Conversely, the older the buyer is, and consequently the shorter his expectation of life, the less his annuity is worth. On the contrary, the less an individual's expectation of life under an insurance contract, the higher must his premium be to accumulate sufficient money in the assumed period to amount to the promised sum. The factor of interest is the same for both; the higher the interest, the lower the premium or the initial sum paid. In the now frequent insurance contracts, where the principal sum is paid to the beneficiary in annuity instalments, the question is one of interest complicated by the probabilities of the beneficiary dying before the payments are completed. More usually now, however, this latter element is eliminated by providing that in such case the remainder shall be paid to the legal representatives, so that it becomes an annuity certain. An interesting concrete illustration of the effect of overrating the mortality is the sale of annuities by the English government under the Northampton Table. This table had figured a correct total of deaths against an incomplete table of births in a given population, and consequently assumed too high a death rate; the government, therefore, fixed the annuity rate too low; and vast quantities of annuities were sold under Mr. Perceval's scheme of 1808 for funding the national debt. The actuaries discovered the miscalculation, and one of them in 1819 warned the government that it was losing $40,000 a month on these contracts; the advice was unheeded; buyers continued to be shrewder than the government and purchased largely of the attractive bargain, and in 1827 another actuary publicly announced that the government was losing $40,000 a week. The next year the sale was suspended, with a total loss to the government of not less than $25,000,000.

ANNULATA, OR ANNELIDS

1

2

3

4

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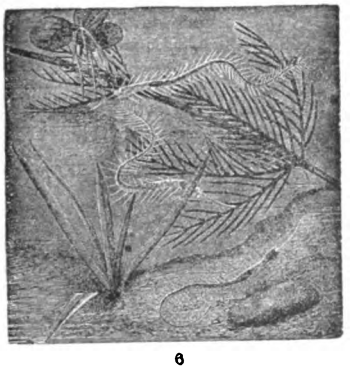

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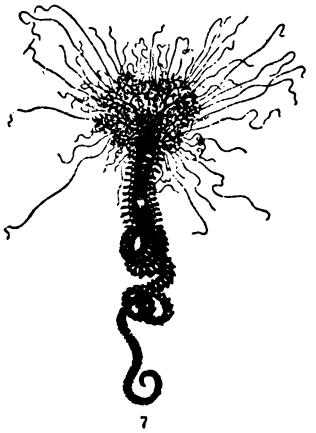

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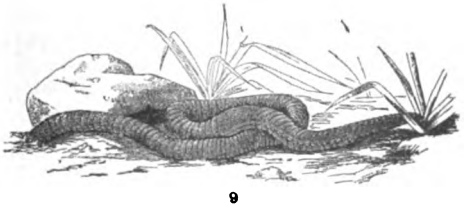

9

10

1 Heteronereis
2 Phyllodoce Laminosa
3 Glycera
4 Arenicola
5 Rock Needle (Pontobdella muricata)
6 Nais Proboscidea
7 Terrebilla Emmalina
8 Hermella
9 Common Earth Worm (Lumbricus agricola)
10 Tubes of Hermella Alveolata

The calculations for annuities are a part of actuarial science. In the United States the following are the approved rates of the best-managed companies: In consideration of $1,000 paid to a company the annuity granted to a person aged 40 would be $52.75; 45, $58.10; 50, $64.70; 55, $73.50; 60, $86.20; 65, $100; 70, $123.45; 75, $145.95; 80, $180.15. But, as stated, the pure annuity, sinking a large sum to buy a yearly income, does not figure largely in America.

Legally the annuity, whether charged to the person of the grantor or on specific real or personal estate, is treated as personal property except for purposes of inheritance or devisement, when it is held to be real property. A rent-charge, however, is a charge on specific real estate only, and is held to be real property under all circumstances. Consult Blackstone, 'Commentary on the Laws of England'; Kent, 'Commentaries on American Law'; Baumgartner, 'Handwörterbuch des gesammten Versicherungswesen' (Vol. I, Strassburg 1898–); Walford, 'Insurance Cyclopædia' (London 1880).

ANNULATA, or **ANNELI'DA**, a term applied to the phylum of sea-worms, comprising the most specialized worms. They are represented by the leeches, the earthworm, the nais of fresh water and the marine annelids. The phylum is divided into four classes: (1) *Chætopoda*, (2) *Gephyrea*, (3) *Archi-annelida* and (4) *Hirudinea*. In the more typical form they are characterized by their long, bilaterally symmetrical body, which is cylindrical, consisting of numerous segments either unarmed, or more usually provided with *setæ* alone, or with *setæ* and paddle-like appendages (*rami*). The head is simple, with a few simple eyes, or provided with tentacles (*antennæ*) alone, or with tentacles and *branchiæ*. An eversible pharynx, armed with teeth, is usually present. The alimentary canal is straight, the tubular stomach sometimes sacculated; the vent is always situated in the last segment of the body. The nervous system is well developed, consisting of a brain and a ventral ganglionated cord. The circulatory system is closed, with a dorsal and ventral, and lateral vessels connected by anastomosing branches in nearly every segment. The sexes are generally separate, but many annelids are hermaphrodites. The embryo passes through a cleavage-stage (morula or blastula), gastrula, sometimes a neurual stage, and after hatching, development is either direct or there is a marked metamorphosis, the larva passing through a trochosphere and cephalala stage. Consult Parker and Haswell, 'Text-book of Zoology' (New York 1897).

ANNUNCIATION, the declaration of the angel Gabriel to the Virgin Mary that she was to become the mother of our Lord (Luke i, 26–38). Annunciation or Lady Day is a feast of the Church in honor of the annunciation, celebrated in the western Churches on 25 March. The institution of this festival is generally assigned to the 7th century. The Italian, formerly Sardinian, order of Knights of the Annunciation (*Ordine Supremo dell' Annunziata*) was instituted by Amadeus VI, Duke of Savoy, in 1360. It received statutes from Amadeus VIII in 1409, was renewed in 1518 and raised to the first order of the Sardinian monarchy in 1720. The subject of the Annunciation has been a favorite with artists from Fra Angelico to Dante Gabriel Rossetti.

ANNUNZIO, än-noon'tzē-ō, **Gabriel d'**, Italian novelist, dramatist and poet: b. Francavilla, a small fishing village on the Adriatic, in 1864. He was educated at the Collegio Cicognini, Prato (Tuscany), and the University of Rome. At the age of 15, while still in the former school, he wrote 'Cincinnato,' his first story, for which the editor of the *Fanfulla della Domenica* paid him 50 francs. So struck was he with the evident talent of the boy that he visited him at college, praised his work before the assembled pupils of the school and prophesied that he would make for himself one of the greatest names in Italy. This visit had much to do with shaping D'Annunzio's life. From that moment he determined to devote himself to literature. It became to him a passion, the one aim of his life. He continued to write stories that were accepted by the press; and while at Prado he composed an ode, 'Lungo le Rive del Romuleo Tebro,' which he dedicated to King Humbert. The sovereign acknowledged the receipt of a copy; and the arrival of the Imperial letter caused a sensation among the masters and pupils of the school and raised the literary enthusiasm of the boy to fever heat. He read widely and wrote with feverish intensity. In his 'Confessiones' D'Annunzio has given a vivid account of the struggle he made to master the Italian tongue. Words were his tools, and to use them as a master he must know them intimately. So he read widely works on science, politics, literature, history, philosophy; and he collected vocabularies of scientific and technical subjects and proceeded to master the meaning of every word therein. He imitated Carducci and the Latin poets and French and German writers. Often he worked 18 out of the 24 hours, writing in complete solitude, while his faithful friend Michetti «stood guard and made his rounds to keep off intruders.» 'Laus Vitæ' was written under these conditions (8,000 lines) practically without interruption.

The publication of his first volume of poems in 1880 made a reputation for D'Annunzio as the most promising of the younger Italian poets. 'Terra Vergine' and 'Canto Novo' (1882) increased his fame. While still in his teens he added to these 'Intermezzo di rime' (1883); and 'Il Libro delle Virgini' (1884). The press of Italy received the boy with open arms and he responded with 'San Pantaleone' and 'L' Isotteo' (1886). When he left the university he became a journalist and contributed largely to the literary columns of the press of the capital. In his 'Confessiones' he states that the first 33 years of his life had passed before he had mastered the art of writing with facility and that, during this literary period of 18 years, he was never able to settle down to one certain style but was constantly vacillating between the many literary claimants upon his attention. In the midst of this active journalistic life he produced 'Elegie romane' and 'Poema paradisiaco.' Then followed a period of still greater literary activity and the production of work of a still superior quality. His first novel 'Piacere,' strongly influenced by the French school of his day, appeared in 1889, and was

followed by a series of novels as remarkable for their style, vivid word painting and analysis of character as anything in Italian literature. These include 'L'innocente' (1891); 'Giovanni Episcopo' (1892); powerful but gruesome stories influenced by the Russian school then popular in Italy; 'Il Trionfo della Morte' (1894), a clever psychological study; 'Le Virgini delle rocci' (1896); and 'Fuoco' (1897). The latter, a "great success of scandal," a powerful story, in its way, brought its author more notoriety than genuine appreciation and thus, like Carducci, he acquired a reputation for literary unwholesomeness which he long failed to live down.

Tiring of novel writing and smarting under the whip of the critics, he turned again to poetry, which he had not altogether neglected, and begun the 'Laudi,' a series of lyrical poems in praise of the sky, the earth, the sea and great heroes. In these, which it was his intention to complete in seven books, his art showed such improvement that his new poetic effort was received with great enthusiasm throughout Italy and, the French reviewers singing his praise, he awoke to find himself an international character.

But D'Annunzio had other fields to conquer. Turning to the drama he produced, in rapid succession, a series of notable plays including 'La Cittá Morta' (1898); 'La Giocconda' (1898); 'La Gloria' (1899); Francesca da Rimini' (1901); 'La figlia di Jorio' (1904); 'La 'fiaccola sotto il moggio' (1905); and two tragedies, 'La Nave!' (1908) and 'Fedra' (1909). The interludes between the writing of these plays he had filled in with a vast amount of journalistic and critical work, poems and short stories. A collection of the latter, 'Novelle della Pescara,' appeared in 1902. The younger literary set of Italy gathered about him, and his became a name to conjure by. 'Forse che si forseghe no' appeared 1910.

On account of the non-moral tone in the characters of many of his novels and short stories, certain critics continued to bitterly attack him; and this, combined with his incessant desire for something new, took him to the French capital where he wrote 'Le Martyre de Saint Sabastien' (1911); 'Le Canzoni della Gesta d'Oltremare' (1912); 'Le Chevrefeulle' (1913); and 'Cabiria,' a very elaborate photo play based upon historical incidents in the second Punic War. 'La Leda senza Cigno' was published in 1917.

When the European War broke out D'Annunzio volunteered as a private in the Italian army, in the aviation squad; and entered into the conflict with all the enthusiasm of his ardent nature. He was rapidly promoted and in May 1915 he was made a lieutenant. Other military honors followed. By his personal example and with his pen and his voice he stirred Italy to the actualities of the war as no other man was able to. In Rome and other cities, in the army and behind the lines, his voice carried the weight of his reputation as the national poet and the mouthpiece of the nation. As the national press representative at the front he wrote some of the most vivid and intimate descriptions of war conditions penned during the European struggle. In January he was decorated with the French Croix de guerre; and this was followed by still other recognitions of his signal service.

D'Annunzio inherited Carducci's literary mantle as the most prominent of his admirers, the most faithful of his disciples and the most ardent of his champions. As a word painter D'Annunzio is an artist of magnificent vision. His style is brilliantly perfect. In every thing he writes is the touch of the poet of plastic beauty unsurpassed in Italian literature. But most of the characters in his novels and shorter stories lack the saving sense of humanity. They rave and rant and make beautiful, poetical, touching speeches and take themselves very seriously; but they do nothing worthy of their high pretensions, nor do they, for the most part, in any way advance the ends of the story; for they are the brilliant dreams of a poet rather than the sane creations of a great novelist and painter of human nature. D'Annunzio is too much the subjective poet to be a great story teller. He misses scores of opportunities to develop his plots when the development is self-evident. The same fault is apparent in his dramas and his short stories. It is as a poet, therefore, that he must live or die. Few if any Italian writers have equalled him in his command of rhythm, his sense of music, his richness, splendor and accuracy of language, his vividness of perception and his wonderful power of reproduction. These, in their highest form, are essentially the gifts of the poet. In his novels, short stories, dramas, tragedies, poems, even in his spectacular photoplay, D'Annunzio is ever the poet; and it is the power of his poetic art that has made him popular in spite of their artistic defects and lack of moral notives. See FRANCESCA DA RIMINI; LA CITTÁ MORTE; LA GIOCCONDA. Consult Borgese, 'Gabriel D'Annunzio' (Naples 1909); Collision-Morley, 'Modern Italian Literature' (Boston 1912); Gargiulo, 'D'Annunzio (Bari 1912); D'Annunzio, 'The Triumph of Death' (New York 1896); 'The Intruder' (New York 1898); 'The Victim' (London 1899); 'The Virgins of the Rocks' (London 1899); 'The Dead City' (Chicago 1902); 'Francesca da Rimini' (New York 1902); 'The Daughter of Jorio' (Boston 1907); 'La Giocconda' (London 1913); 'The Butterfly' (London 1915).

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ANNUS MIRABILIS, the year 1666, famous in English history for two decisive victories over the Dutch fleet, and for the great fire of London. Dryden's poem of this name, published in 1667, commemorates these events, and is dedicated to "the Metropolis of Great Britain, the most renown'd and late flourishing City of London."

ANNVILLE, Pa., township in Lebanon County, five miles west of Lebanon, the seat of Lebanon Valley College, an institution controlled by the United Brethren in Christ. It was founded in 1762. Pop. (1910) 2,482.

ANOA, a genus of Malayan buffaloes, particularly the small black species, with low, erect horns, called sapi-utan (*A. depressicornis*), and found in the highlands of Celebes. The genus was once classed with the antelopes.

ANOBIUM, a genus of beetles belonging to the family *Ptinidæ*. It contains the deathwatch insects, *A. striatum, A. tesselatum,* etc.

ANODE, the name given by Faraday (in 1832) to the electrode, or terminal, at which a current of positive electricity enters a battery or other electrical apparatus in which chemical work is performed. The term has since been extended so as to include the electrode by which a positive electric current enters a vacuum tube. The other electrode, in every case, is known as the "cathode." The anode of a primary battery (see BATTERY) commonly consists of a plate or rod of zinc, while the cathode consists of a plate of carbon, or copper, or platinum. In electrolysis the anode and cathode both consist, usually, of platinum or carbon. In a vacuum tube the anode commonly consists of a wire or disk of platinum, while the cathode (which is varied in shape according to the purpose to which the tube is to be put) is usually made of aluminum or platinum.

ANODONTA, a subdivision of the fresh-water mussels (q.v.), abundant in the streams and lakes of the United States and most temperate countries. They have smooth, thin shells without hinge-teeth.

ANODYNES. See ANALGESICS.

ANOINTING, an Oriental custom of applying oil to the head or unguents to the body. The Greeks and Romans, particularly the former, anointed themselves after the bath. Wrestlers used unguents in order to render it more difficult for their antagonists to get hold of them. The use of oil for ceremonial purposes is equally ancient. Its first mention is in Gen. xxviii, 18, where Jacob, in commemoration of a remarkable dream, is said to have set up a pillar and poured oil upon it. In the Mosaic law and several ancient religions a sacred character was attached to the anointing of the garments of the priests and things belonging to the ceremonial of worship. This could be done only with oil made for the purpose, and signified a consecration of the articles to the service of religion. Jewish priests and kings were anointed when inducted into office, and were called the anointed of the Lord, to show that their persons were sacred and their office from God. The Old Testament prophecies respecting the Redeemer style him, on account of his royal descent and his dignity, Messias, that is, the Anointed, which is also the meaning of his Greek name Christ. The custom of anointing still exists in the Roman Catholic and Oriental Churches (see SACRAMENTS), and is also frequently a part of the ceremony of coronation.

ANOKA, ä-nō'kă, Minn., a small city, the county-seat of Anoka County, with manufactures of lumber, flour, machinery, a sash and door factory, a motor company and a starch factory. It is 18 miles north-northwest of Minneapolis on the Great Northern, Minneapolis Northern and the Northern Pacific railways and on Rum River. The commission government chosen (1913) provides for election of mayor and four commissioners biennially. Both water works and electric light plant are owned by the municipality. Pop. (1910) 3,972.

ANOLIS, a genus of slender, long-tailed, iguanid lizards of the American tropics, which are expert climbers and seek their insect food principally in trees and bushes. They have a pouch under the throat and the ability to change color. It is not surprising, therefore, that one of the species (*A. carolinensis*), a beautiful golden-green lizard, very common in our Southern States, and often kept as a pet, should be called the American chameleon. About 100 other species are known. See CHAMELEON.

ANOMALY, a deviation from a rule. That which deviates is called anomalous. In astronomy the true anomaly is the angle which a line drawn from a planet to the sun has passed through since the planet was last at its perihelion or nearest distance to the sun. On account of the planets not moving with the same velocity at all parts of their orbits, this angle does not increase uniformly; hence its name. The anomalistic year is the interval between two successive times at which the earth is in perihelion, or 365 days 6 hours 13 minutes 48 seconds. In consequence of the advance of the earth's perihelion among the stars in the same direction as the earth's motion and of the precession of the equinoxes, which carries the equinoxes back in the opposite direction to the earth's motion, the anomalistic year is longer than the sidereal year, measured by the sun's return to the same position among the stars, and still longer than the tropical or common year, measured by the earth's return to the same equinox. It exceeds the latter by 25 minutes.

ANONA, ä-nō'-nä, a name given in Mexico, Central America and the countries of the west coast to the chirimoya and sometimes to other members of the Anonaceæ family.

ANONYMOUS, a term applied to a work the author of which does not give his name. There are no rules about the signing of names to works in Great Britain and the United States. Consult Cushing, 'Anonyms' (Cambridge, Mass., 1890), and 'Initials and Pseudonyms' (1st series, New York 1885; 2d series, id. 1888); Halkett and Laing, 'Dictionary of Anonymous and Pseudonymous Literature' (4 vols., New York 1882–88); Hamst, O., 'Handbook of Fictitious Names' (London 1868).

ANOPHELES, a genus of *Culicidæ* (mosquitoes), embracing those species of blood-sucking mosquitoes which carry and communicate to human beings, by biting, malarial diseases. See MOSQUITO.

AN'OPLOTHE'RIUM, an extinct primitive ruminant fossil in the Upper Eocene formations of Europe. It was among the first fossil vertebrates discovered in the gypsum quarries of Montmartre in Paris and was named by Cuvier in 1822 from its defenseless character (Gr. *ἀνοπλος*, unarmed; *θηρίον*, beast), as it has neither tusks nor horns to protect itself from its carnivorous enemies. They form the type of a distinct family, in many respects intermediate between the swine and the true ruminants.

ANORTHITE, a triclinic feldspar, having the composition of a silicate of aluminum and calcium, $CaAl_2Si_2O_8$. It is especially interesting to the chemical mineralogist because it stands at one end of the albite-anorthite series of feldspars (see FELDSPARS). Its cleavage is in perfect parallel with the base and distinct parallel with the brachypinacoid. It is brittle, breaking with a conchoidal to uneven fracture. Its hardness is 6 to 6.5 and specific gravity about

2.75. It is usually colorless or white, sometimes grayish or inclining to brick-red. It occurs in glassy crystals in the ejected blocks at Mount Vesuvius, Italy.

ANOSMIA, the loss of the sense of smell. This may be produced by: (1) Injury to the nerves of smell as they originate in the mucous membrane of the nose, in chronic nasal catarrh, in polypi or in injury to the nose. (2) By injury to the olfactory bulbs or to the olfactory tracts. Such injuries occur in severe blows or falls, particularly in fracture of the ethmoid plate accompanying fracture of the skull. (3) By injury to the brain centres of smell, which are located in and about the uncinate gyrus. See SMELL.

ANSARIES. See NOSSAIRIANS.

ANSCHAR (ANSGAR or ANSKAR), French prelate: b. near Amiens, 801; d. Bremen, 3 Feb. 865. He was educated at the monasteries of Corbie and of Korvei. He belonged to the Frankish nobility and under the patronage of Louis le Débonnaire, together with Autbert, went to preach Christianity to the Northmen of Schleswig. Here he endured many persecutions but succeeded sufficiently to have the Pope establish an archbishopric in Hamburg. Anschar was made the first archbishop in 831. When Hamburg was overrun and plundered by the Danes in 845, Anschar was obliged to flee. Later he preached in Denmark and Sweden. A church was named after him at Bremen. He was canonized by the Roman Catholic Church. He was the author of a life of Saint Willehad. His feast is celebrated on 3 February. Consult lives by G. H. Klippel (Bremen 1845) and Tappehorn (Münster 1863); also Butler, A., 'Lives of the Saints' (London 1847).

ANSELM, Saint, a celebrated theologian, regarded by some as the founder of scholasticism: b. Aosta, in Piedmont, 1033; d. Canterbury, 21 April 1109. At 27 he became a monk at Bec in Normandy, whither he had been attracted by the celebrity of his countryman Lanfranc, then prior of the monastery there. When Lanfranc was promoted to the abbacy of Caen, Anselm was elevated to the dignity of prior and in 1078 he was made abbot, which office he retained for 15 years. During this period he wrote his first philosophical and religious works: the dialogues on 'Truth and Free-will,' 'De Veritate' and 'De Libertate Arbitrii' and the treatises 'Monologion' and 'Proslogion,' and at the same time his influence made itself so strongly felt that Bec became the chief seat of learning in Europe. In 1093 Anselm was offered the archbishopric of Canterbury, which had lain vacant since the death of Lanfranc in 1089, and accepted the offer, though with great reluctance and with the condition that the King of England, William Rufus, should acknowledge Pope Urban in opposition to the antipope Clement, which the King ultimately consented to do. In 1097, a new difficulty having arisen between Anselm and William, the former set out for Rome to consult with the Pope. Urban received him with great distinction, but did not venture to declare himself on the side of the prelate in his dispute with the King. Meanwhile William had seized on the revenues of the see of Canterbury, which he retained till his death in 1100. Anselm accordingly remained abroad, where he wrote his celebrated treatise on the atonement, 'Cur Deus Homo.' When William Rufus was succeeded by Henry I, Anselm was recalled. His canonization seems to have taken place in 1494. All the works of Anselm are directed toward founding a reasoned system of Christian truth. Such a system he considered to be a legitimate demand of reason, although he repeats again and again the doctrine that faith is necessary to the intelligence of the Christian mysteries, that the teaching of revelation must first be accepted by faith and afterward shown to have the support of reason. His celebrated ontological proof of the existence of God is to be found in the 'Proslogion.' The 'Cur Deus Homo,' treating, as already mentioned, of the atonement, is the most important of Anselm's works. In order to satisfy the reason of the need of an atonement and of the efficacy of the particular atonement that the Christian religion represents as having been made in the death of Christ, Anselm endeavors to establish the following positions: First, that God's honor is wounded by sin and His justice therefore requires satisfaction; second, that this satisfaction can be given only through one who is at once God and man; and third, that the voluntary death of Christ actually accomplished this satisfaction. The works of Anselm have often been published. The last complete edition forms the 155th volume of Abbé Migne's 'Patrologiæ Cursus Completus.' Among the numerous separate editions of the 'Cur Deus Homo' may be mentioned those of Lämmer (Berlin 1857) and Fritzsche (Zürich 1868). Anselm's personal character, distinguished by single-mindedness, gentleness, large-heartedness and piety, makes him one of the brightest ornaments of the Christian Church. Consult Eadmer, 'Vita Anselmi'; the works of Franck (1842); Hasse (1843–52); Rémusat (1853); Church, R. W. (1870); Rigg (1896) and Welch (1900).

ANSERES (Lat. nom. plur. of *anser*, goose), an order of water-birds, chiefly marked by the series of tooth-like projections on the edges of both mandibles, so placed that those on the upper mandible fit into the spaces between those on the lower when the mandibles are closed. Ducks, geese and swans (qq.v.) belong in this order and some classifications also include the screamers. They live and breed near the water, are found in all parts of the world, and are usually of large size. As a rule, they are swimming-birds and their numerous young need but little care. About 200 species are known.

ANSON, George, LORD, a celebrated English navigator: b. Shugborough, 23 April 1697; d. Moor Park, 6 June 1762. He entered the navy at an early age and became a captain in 1724. In 1740 he was made commander of a fleet sent to the South Sea, directed against the trade and colonies of Spain. The expedition consisted of five men-of-war and three smaller vessels, which carried 1,400 men. After much suffering and many stirring adventures he reached the coast of Peru, made several prizes and captured and burned the city of Paita. His squadron was now reduced to one ship, the Centurion, but with it he took the Spanish

treasure galleon from Acapulco, arriving in England in 1744, with treasure to the amount of £500,000, after having circumnavigated the globe. His adventures and discoveries are described in the well-known Anson's 'Voyage,' compiled from materials furnished by Anson. His victory over the French admiral Jonquière, near Cape Finisterre in 1747, raised him to the peerage with the title of Lord Anson, Baron of Soberton. Four years afterward he was made First Lord of the Admiralty. In 1758 he commanded the fleet before Brest, protected the landing of the British at Saint Malo, Cherbourg, etc., and received the repulsed troops into his vessels.

ANSON, William Reynell, Rt. Hon. Sir, 3d baronet: b. 1844; d. Oxford, 4 June 1914. A famous English jurist, educated at Eton and Oxford, where he won some of the highest academical distinctions. He practised at the bar till 1873; was appointed Vinerian reader in English law at Oxford (1874); where he took an active part in promoting the foundation of a school of law. In 1880 he made a bid for parliamentary honors as a Liberal, unsuccessfully. Elected warden of All Souls' College in 1881; became a member of the Hebdomadal Council in 1884 and vice-chancellor in 1898. In 1899 he was elected M.P. for Oxford University, but as a Unionist. In 1902 he was made parliamentary secretary of the Board of Education and, as the representative of the Education Department in the House of Commons, he had much to do with defending and bringing into operation the Education Act of 1903. He established an enduring reputation by his great work, 'The Law and Custom of the Constitution' (1881), a monument of learning and lucid exposition and the most trustworthy guide to the complex machinery of British government. It is the textbook from which British statesmen have to learn their business. His other chief work, 'The Principles of the Law of Contract' (1879), has also become a standard classic. Sir William Anson was a trustee of the British Museum — an honor more difficult of attainment than a mere peerage. The future King of England received his instruction in constitutional history from him. As Anson died unmarried, the baronetcy passed to his nephew, Sir Denis Anson, a very young man, who was drowned in the Thames a month later.

ANSON, Tex., town and county-seat of Jones County, on the Wichita Valley and the Abilene Southern railroads, 150 miles west of Fort Worth. The town is located in the midst of a fine agricultural country and has extensive cotton and live stock interests. It contains cotton gins, confectioneries and a municipal waterworks, two banks with combined resources of $140,000, a common school and a high school and five churches. The value of taxable property is $625,000 and the municipal revenue amounts to about $7,500. The town is under the commission form of government. Pop. 2,500.

ANSONIA, Conn., city of New Haven County, situated on the Naugatuck River, a few miles above its junction with the Housatonic, and on the New York, N. H. & H. Railroad, being also the terminus of the New Haven and Derby branch; 12 miles northwest of New Haven. Among its public buildings are the Anson G. Phelps public library, a memorial to the founder (in 1840) of the city, and the city hall. Ansonia has extensive manufactories of brass and copper goods, clocks and clock equipments, movements, etc., electrical supplies, flour, lumber and lumber products, foundries and machine shops, etc. According to the United States census of manufactures in 1914, there were 42 establishments of factory grade employing 4,882 persons, of whom 4,312 were wage-earners, receiving annually $2,412,000 in wages. The capital employed was $16,535,000 and the year's output was valued at $21,499,000; of this, $4,287,000 was added by manufacture. Since 1909 the capital in Ansonia's industries has increased 69.4 per cent and the output has increased 7 per cent. It was formerly a part of Derby and received its city charter from the legislature in 1892. Pop. (1910) 15,152; (1916) 17,500.

ANSWER, in law, a defense in writing, made by a defendant to charges contained in a complaint filed by the plaintiff against him in a court of law. In all the code States a statute similar in its provisions to § 500 of the New York Code of Civil Procedure has been adopted. This section provides that the answer of the defendant must contain: (1) A general or specific denial of each material allegation of the complaint controverted by the defendant, or of any knowledge or information thereof sufficient to form a belief; (2) a statement of any new matter constituting a defense or counterclaim, in ordinary and concise language, without repetition.

ANT, a small social insect of the family of *Hymenoptera,* characterized by unusual distinctness of the three regions of the body, head, thorax and abdomen and by the stack or petiole of the abdomen having either one or (rarely) two "scales" or "nodes," so that the abdomen moves very freely on the trunk or thorax. The antennæ are elbowed as in wasps and bees. Ants live in societies, consisting, besides the males and females, of smaller wingless workers. In all ants, except the *Odontomachidæ* and *Dorylidæ,* the mandibles are wide apart at the base or insertion, so that they can be used without the other appendages of the mouth being opened or even moved. Both males and females are winged, but the males are much smaller than the females, while the wingless workers are smaller than the males. In these wingless forms the segments of the thorax become more or less separated, making the body much longer and slenderer and less compact than in the winged normal sexual forms, the prothorax being more developed than in the males and females. The workers often consist of two forms: one with a large cubical head, or worker major, sometimes called a soldier, and the usual small-headed form, or worker minor. In certain genera this polymorphism (q.v.) is still more marked. The legs are usually long and slender, the tarsi are five-jointed as usual in *Hymenoptera,* but the front or basal joint is disproportionately long, so that it functions as if part of the tibia; the tibias of the fore pair of legs are furnished with comb for cleaning the antennæ and mouth

appendages. A sting is sometimes present, as in the *Poneridæ*, which sting like wasps and bees and in the *Myrmicinæ*, while in the workers of ordinary ants it is either vestigial or entirely wanting. Some ants secrete an active poison (formic acid), which they inject into the wound made by their jaws in biting. In the *Formicinæ*, whose sting is atrophied, the amount of poison secreted is "relatively enormous" (Janet). Our *Formica obscuripes* is a very ferocious species and, like the European *F. pratensis*, rises upon its hind legs, curves the abdomen and ejects its venom, while Muckermann adds that the ejection of formic acid is so copious as to enforce the observer to momentarily retire.

The larvæ of ants are uniformly maggot-like, being legless, soft-bodied, cylindrical and with a small head bent on the breast. They are helpless and are fed by the workers.

Wheeler has shown that different species of ants employ very different methods of feeding their larvæ. Some (those of *Camponotus, Formica, Lasius* and *Myrmica*) feed their young with liquid food regurgitated from their crops and possibly also with the secretion of the salivary glands. Other species, however, *Ponerinæ* and some *Myrmicinæ*, feed their larvæ with comminuted insects. Wheeler states that the larvæ of certain ants "are not only able to subsist on solid food, but even on food of a vegetable nature."

The larvæ of the stingless genera usually spin a delicate silken cocoon, while those of the aculeate genera do not. Within the cocoon the larva transforms into the pupa.

Nesting Habits.— The history of a formicarium, or ants' nest, is as follows: The workers only (but in some species the winged ants) hibernate and are found early in the spring taking care of the eggs and larvæ produced by the autumnal brood of females. Every ant colony is founded by a single fertilized female. In the course of the summer the adult forms are developed, swarming on a hot, sultry day. The small yellow ants, abundant in paths and about houses in New England, generally swarm on the afternoon of some hot day in the first week of September, when the air is filled toward sunset with myriads of them. The females, after their marriage flight in the air, may then be seen entering the ground to lay their eggs for new colonies, or they are often seized by the workers and retained in the old colonies. Having no more use for their wings, they pluck them off and may be seen running about wingless. The female, after laying her eggs, does not go abroad in search of food, but feeds the young larvæ with food regurgitated from her stomach and derived from her fat-bodies; thus the larvæ are poorly fed and become workers.

Nests.— The nests of some species of *Formica* are six feet in diameter and contain many thousand individuals. Ants also build nests of clay or mud and inhabit hollow trees. Ants in Europe build true mounds, sometimes three feet high, but in North America they are mostly subterranean, though in Wisconsin one ant (*F. obscuripes*) erects a true mound about 20 inches high.

Formica sanguinea is one of our most abundant species, making hillocks of sand or clay, according to the nature of the ground. From the formicary walks and underground galleries radiate in a labyrinth in all directions; and deep down, where the soil is perpetually moist, the galleries descend to a relatively greater depth than in Europe. Packard has found a variety of this species in Labrador, where it is common. It does not throw up hillocks, but tunnels in the earth. The nest of *Œcophylla smaragdina* is formed by drawing together a number of green leaves, which are united with a fine web. Some nests are a foot in diameter. This species swarms in hilly forests in New Guinea. Its sting is not very severe.

It is in argillaceous countries especially that the Œcodomas build their enormous formicaries, so that one perceives them from afar by the projection which they form above the level of the soil, as well as by the absence of vegetation in their immediate neighborhood. These nests occupy a surface of many square metres and their depth varies from one to two metres. Very many openings, of a diameter of about one to three inches, are contrived from the exterior and conduct to the inner cavities which serve as storehouses for the eggs and larvæ. The central part of the nest forms a sort of funnel, designed for the drainage of water, from which, in a country where the rains are often abundant, they could hardly escape without being entirely submerged if they did not provide some outlet for it.

The "agricultural ant" myth has been exploded by Wheeler, who shows that these ants do not plant grass seeds or "ant-rice" for a harvest. It is probable that Lincecum's error was due to the fact that the sprouted seeds stored up and then cast away as inedible take root and thus form a partial circle of tall grass around the nest.

Mushroom Gardens.— Möller has described what he calls "mushroom gardens" made by several South American species of *Atta*. The ants cut and bring the large pieces of leaves into their cellars, then cut them into smaller fragments and finally comminute these still further till they form a flocculent greenish-brown pulp. This pulp is heaped up and soon becomes invaded by the mycelium of a fungus (*Rozites gongylophora*). The mycelium is kept aseptically clean — that is, free from all other species of fungi and even from bacteria — and induced to grow in an abnormal way by bringing forth minute swellings which constitute the only food of the ant colony. Möller likens these swellings to the *kohlrabi* of the German kitchen gardens.

Forel has studied the habits of two other species (*Atta cephalotes* and *A. sexdens*) in Colombia, in relation to this process of collecting and comminuting the leaves and in cultivating the mushroom. He has found that the largest workers (soldiers) triturate the leaves and defend the nest. They draw blood when they fight. The indigenes are said to use these insects for closing wounds. They induce them to bite the two lips of the wound and thereupon sever the bodies from the heads, which then serve as a suture. The medium-sized workers cut the leaves from the trees, while in the nest the workers of the *minim* caste are forever clipping the threads of the mycelium of the *Rozites*, which then develops the *kohlrabi* on which the ants feed.

Wheeler excavated a large nest of leaf-cutting ants (*Atta fervens*) in a piece of woodland in Texas. The large burrows, nearly an inch in diameter, were found to extend down to a depth of from three to five feet, and to open into large chambers, some of which were fully 10 inches across and five to eight inches high. A few of these chambers were traversed by the roots of a large cedar, in the shade of which the ants had dug their formicary. Mushroom gardens were found heaped upon the floor, or, more rarely, enveloping, as aërial or "hanging" gardens, the roots that extended across the chambers.

The shape of a mushroom garden is that of a discoidal sponge. On its upper surface the ants pile up the flocculent vegetable débris, threaded in all directions with fungus hyphæ, in the form of thin, vertical, anastomosing plates, so that as much surface as possible is exposed to the atmosphere of the chamber. This atmosphere must contain a great amount of carbon-dioxide and a very small amount of oxygen. The ants leave several tubular or funnel-shaped openings, varying in diameter, and extending down into some chambers excavated in the base of the vegetable mass. In these chambers lives the huge queen of the colony (an insect nearly an inch long), the newly-fledged males and virgin queens, together with the larvæ, pupæ and attendant ants. The whole mushroom garden swarms with workers representing all the different castes so characteristic of the genus *Atta*. The big-headed soldiers stalk about slowly over the surface of the comb, descending from time to time into the interior, as if to make sure that the great family is properly attending to its multifarious occupations, while thousands of *minims* keep moving about through the meshes of the mycelium, weeding the garden.

Relation of Quality and Quantity of Food to the Production of the Sexless Workers.— As is obvious, since the workers rarely lay eggs, the worker caste is not inherited either directly or collaterally from the parents. The view now suggested and supported by a considerable body of facts is that the larvæ on hatching are at first all alike and that those which become workers are fed with different as well as less food than those which develop into sexual individuals. We know that the differences between the queen and the worker bees are due to differences in the nature of the food. The worker white ants have been found by Grassi to be the result of having different food and less of it than the males or females. Wasmann believes that the large workers of *Polyergus rufescens* ("ergatoid females") are produced by the slave ants (*Formica fusca*), living in the colony, through excessive care and feeding of certain larvæ,—that is, that the *fusca* workers or slaves attempt to change worker larvæ of *Polyergus* into queens, but succeed only in producing the wingless ergatoids. Emery also holds that the sexual polymorphism of the ant colony is the result of the development of an instinct in the workers to feed the larvæ in different ways and thus the characters in which the worker differs from the corresponding sexual forms are not congenital but acquired.

As has been said, the female ant, on founding a new colony, herself lives and nourishes the freshly-hatched larvæ with food from her stomach, ultimately from the fat-body. Hence these larvæ of the first brood are poorly fed and become small or dwarf workers (micro-ergates). These workers leave the nest and bring in food to their half-starved parent. Thus fed she becomes more prolific, lays another batch of eggs and the larvæ become larger and finally change into larger-sized workers. The colony thus becomes more populous and, as Wheeler states, the workers of successive broods grow larger until they attain the full stature of the species. Then and not till then do the workers bring up the males and queens, which are carefully herded, fed and groomed by the workers until ready for the marriage flight. In some species of ants the males and virgin queens do not appear till the second or third year after the colony is founded. In a few American species of the huge cosmopolitan genus *Pheidole*, Wheeler and others find that the large-headed and small-headed or dwarf workers are connected by a perfect series of intermediate forms and this is due to the varying quantity of food. After an unfavorable season (autumn and winter) of drought and cold the number of *Pheidole* soldiers was unusually small. Thus Grassi's view as to the origin of the polymorphic forms in the termites being dependent on the quality and quantity is borne out by recent observations on ants.

Polymorphism and Variability of Ant Castes.— No solitary ants are known to exist, in all besides the males and females there are workers, and this is the direct result of their social mode of life. In our common species there is only one kind of worker, those in which the head is of uniform size, no big-headed ones or soldiers. But in ants collectively, though not in any one genus, there may be eight sets of individuals — that is, ordinary males and "ergatoid" males, ordinary females and ergatoid fertile females, and exceptionally (*Formica rufa*), a set intermediate between the female and the worker; there are also soldiers, worker-majors and one or more kinds of worker-minors. The adult, sexually capable, though wingless forms, are called by Forel "ergatoids" from their resemblance to workers (Ἐργατης, a worker), this term is applied to both sexes. The worker females differ from the normal-winged female in the lack of a *receptaculum seminis*. The greatest number of castes in any one genus is five, occurring in *Eciton, Cryptocerus*.

Wheeler shows that polymorphism and variability depends on the amount and nature of the food and the increase in the population of the colony, and on the care and protection afforded to the reproductive individuals of the colony. There is, on the other hand, little variation in colonies which are poorly fed and therefore unable to increase rapidly in number.

Primitive Ants.— Two primitive subfamilies of ants, the *Dorylinæ* and *Ponerinæ*, appear to have been evolved from a still more primitive and ancestral group, the *Cerapachynæ*, which Wheeler with good reason claims to be "the most archaic and generalized of existing *Formicidæ*." This group, species of which occur in Africa, southeastern Asia, Australia and the southwestern United States (Texas) is represented in this country by *Cerapachys*, which mines the ground for a few inches under stones.

The colony appears to be unusually small, the queen is wingless and the workers quite blind, and its life appears to be wholly subterranean, yet possesses senses of contact, odor (judging by the thick antennæ), and of hearing (it has "a beautifully developed stridulatory apparatus, which occupies the whole of the large membrane between the postpetiolar and first gastric segment") (Wheeler). This form, as Emery points out, seems to be the nearest of any ants to the *Mutillidæ*, especially the genus *Apterogyna*, which has an ant-like pedicel to the abdomen, and also resembles the ants in other features. That this group is also a very primitive one is shown by the plastic forms of females, of which there are four kinds, significant, as Wheeler remarks, "as the phyletic source to which the different female forms of all the subfamilies of ants are to be traced."

Slavery.— This phase of social life is not infrequent among ants, and it reacts upon the slaveholders by rendering them helpless. *Formica sanguinea* has been observed in Europe by P. Huber to go on slave-hunting expeditions. They attack a "negro colony" belonging to a smaller black species, pillaging the nests and carrying off merely the larvæ and pupæ. The victors educate them in their own nests, and on arriving at maturity the negroes take the entire care of the colony. *Polyergus rufescens* is also a slave-making ant, and Latreille very justly observes that it is physically impossible for the rufescent ants (*P. rufescens*), on account of the form of their jaws, and the accessory parts of their mouths, either to prepare habitations for their family, to procure food or to feed them. *Formica sanguinea* sallies forth in immensely long columns to attack the negro ant. Huber states that only five or six of these forays are made within a period of a month, at other seasons they remain at peace. Huber found that the slave-making *Polyergus rufescens*, when left to themselves, perish from pure laziness. They are waited upon and fed by their slaves, and when they are taken away their masters perish miserably. Sometimes they are known to labor, and were once observed to carry their slaves to a spot chosen for a nest. The *Formica sanguinea* are not so helpless; they assist their negroes in the construction of their nests, they collect their sweet fluid from the *Aphides*; and one of their most usual occupations is to lie in wait for a small species of ant on which they feed; and when their nest is menaced by an enemy they show their value of these faithful servants by carrying them down into the lowest apartments, as to a place of the greatest security. Pupæ of both the slave-making species were placed in the same formicary by Huber, where they were reared by the "negroes," and on arriving at maturity lived together under the same roof in the most perfect amity. Darwin states that in England *Formica sanguinea* does not enslave other species.

In this country forays of a colony of *Formica sanguinea* upon a colony of a black species of *Formica*, for the purpose of making slaves of them, has been not infrequently observed. Slavery (*duloris*) is known to exist only between ants belonging to the same subfamily, the species of only four genera being known to practise slavery. In Europe the "paragon of dulotic ants" is *Polyergus rufescens*, or the "amazon" ant, as the workers are very warlike, though they are in other respects helpless and completely dependent on their slaves, dying of starvation if deprived of them. Darwin's explanation of the origin of the slave-making habits is that they were originally due to the predatory instincts of ants in general, seen in their carrying off the pupæ of other species, which, becoming stored as food, and finally developing would in their new abode do what work they could; and this habit of collecting pupæ for food might be rendered permanent for the purpose of raising slaves.

Sound Produced by Ants.— Certain species of ants are evidently not deaf, because capable of producing sounds which must be heard by others of their own kind. Thus *Myrmica rubra* has a sound-producing apparatus, a strigil, or file on the seventh abdominal segment (Janet); another ant of this group (*Sima lævicepS*) is provided with a stridulating file; and in the ronerids there is a stridulating organ consisting of a band of very fine raised lines on the second segment behind the node. Other ants (*Polyrhachis*) tap on the surface of a leaf with their heads, producing a sound audible to human ears, as does an Assamese species by scraping the end of its abdomen on the dry leaves of its nest.

Senses of Ants.— While ants may be blind and deaf, none are known to be destitute of the sense of smell. The olefactory organs are little sensory pits in the antennæ. It is undoubtedly by means of their sense of smell that ants recognize the members of their own nest, and those of other species which they treat as enemies. It is probably by this means that they distinguish their friends from their enemies. Thus the cause may be the result of reflex action, rather than any special degree or kind of intelligence.

Parasitic Ants with No Workers.— Such are the ants of the genera *Anergates* and *Epœcus*; in the former the male and females are helpless, incapable of leaving the nest and dependent on the attentions of the workers of another genus (*Tetramorium*) which live with them. This strange relationship seems thus far inexplicable.

Symbiosis in Ants.— The relation between ants and plants is very intimate, and it assumes different phases. See SYMBIOSIS.

Commensalism.— Ants' nests are so many apartment or boarding hives. A vast number of beetles, aphides, cockroaches, flies and arachnids take up their abode in the nests of ants, where they are allowed by their willing or unwilling hosts to feed on the excretions of the ants themselves or their food. The fostering instincts of ants thus seem to be extended in various degrees to their guests and thus lay the foundation for this semi-parasitic community. Upward of 1,500 species of *Arthropoda* are known to live in more or less cordial relations with their hosts.

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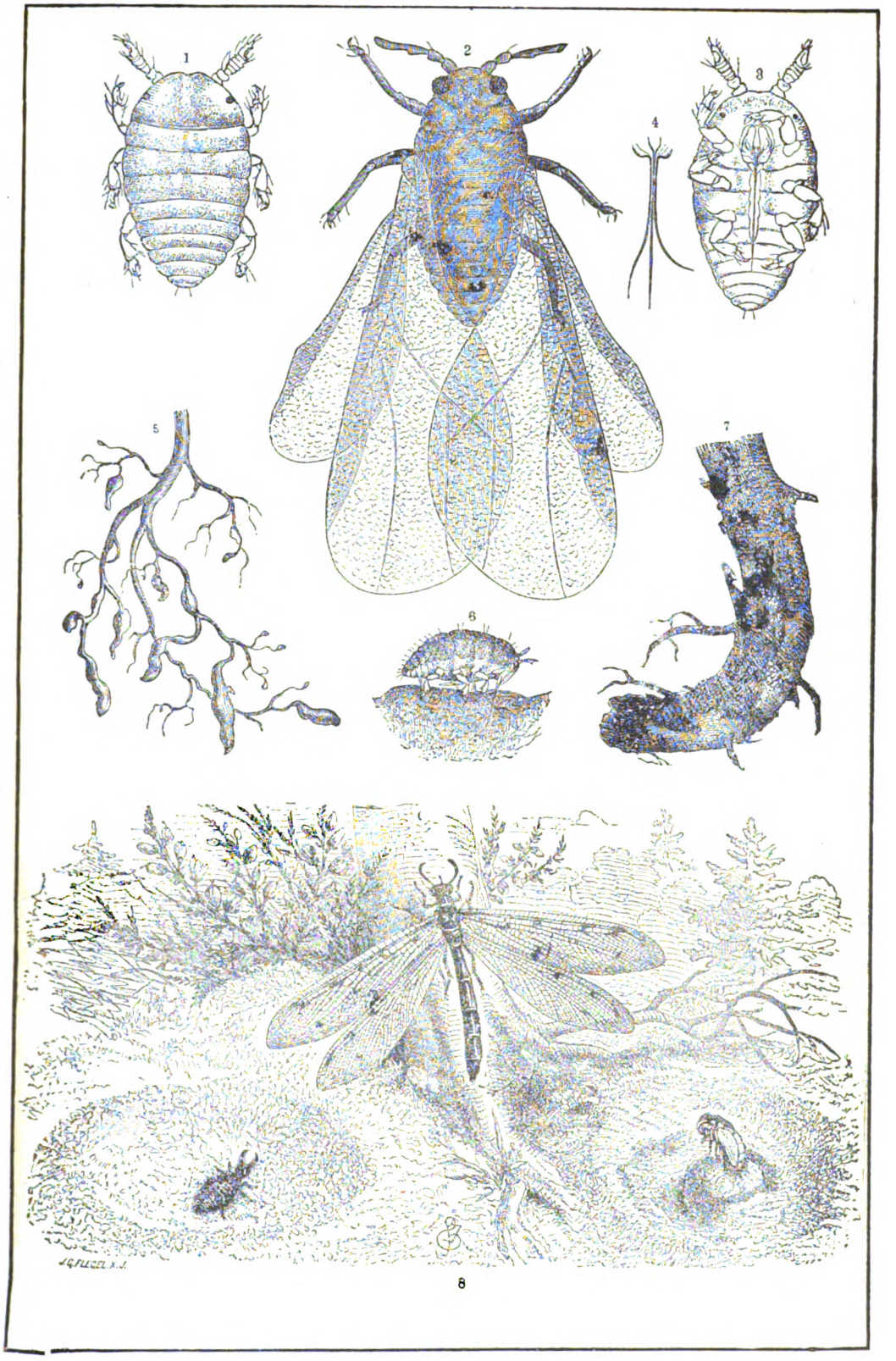
APHIS AND ANT-LION



1–7 Phylloxera Vastatrix
1–3 Larva, Front and Back View
2 Adult Insect
4 Mouth parts
5 Grape Vine Root in which the Insects are working
6 Larva, Side View
7 Old Root, with Colonies of Lice
8 Ant-Lion (Myrmeleon formicarius). Showing Pupa, Larva and Adult Stages

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ANTACIDS, or **ALKALIES,** drugs which correct abnormal acidity of the digestive tract or the secretions of other organs. Direct antacids are those that unite directly with acid in the stomach and intestines; the principal are ammonia, magnesia, potassium, bicarbonate, chalk and lime water. The acetates, citrates and tartrates of the alkalies act by being changed into carbonates, and increase the alkalinity of the blood, which diminishes the acidity of the urine, and are called indirect or remote antacids. Direct antacids are given after meals to neutralize an excess of the hydrochloric acid of the stomach resulting from fermentation of the food. Remote antacids are extensively used in the treatment of gout and rheumatism.

ANTÆUS, ăn-tē'ŭs, the giant son of Poseidon (Neptune), and Gē (the earth), who was invincible so long as he was in contact with the earth. But Heracles (Hercules), whom he challenged to combat, perceiving the secret of his strength, lifted him in the air and strangled him.

ANTALCIDAS, Spartan statesman, chiefly known by the celebrated treaty he concluded with Persia at the close of the Corinthian War in 387 B.C. The peace which followed was styled «The Peace of Antalcidas.»

ANTARCTIC REGIONS, the name given to part of the earth's surface surrounding the South Pole. Its limits are variously defined by geographers; some consider it to be coextensive with the Antarctic Ocean, which in a strict sense is bounded by the Antarctic Circle, while others include also that portion of the great Southern Ocean affected by Antarctic influences. According to the latter interpretation the region is approximately defined by the northern limit of the drifting pack-ice or about lat. 50° S., although icebergs are sometimes encountered as far north as lat. 45° S. The Antarctic region is surrounded by a great expanse of shoreless water which further north is divided by the continental lands into the Atlantic, Pacific and Indian Oceans. The area comprised within the Antarctic Circle is about 8,200,000 square miles.

Exploration.— The early explorations into the region south of the equator and the discovery of numerous lands gave rise to the belief that a vast continent existed near the South Pole. The first voyage of Captain Cook in 1769 showed, however, that New Zealand, contrary to the general opinion, was an island, and in his second voyage, in 1772, it was proved that the continent, if it existed, did not extend beyond the Antarctic Circle. In 1773 Cook sailed south again and the following year reached lat. 71° 10′ S. in long. 106° 54′ W., where he was prevented from advancing further by enormous ice-floes. No land was seen on this voyage, although its presence was indicated by flights of birds. In 1819 Captain Smith rounded Cape Horn and sighted the South Shetland Islands, while in the following year Alexander Land still farther south was discovered by Bellingshausen. Morrell, an English explorer, sailing in 1822, visited the Falkland Islands, Bouvet Islands and South Georgia, and reported that he found the temperature of both air and water to be milder the farther he advanced southward. Biscoe circumnavigated the southern ice region in 1831–32, penetrating beyond lat. 67° S.; he discovered Enderby Land and its southwestern extension, which he named Graham Land. Kemp sighted and marked Kemp Land in 1833. The Balleny Islands were discovered by Balleny in 1839, and D'Urville, in 1839–40, made a long voyage during which he visited many of the previously discovered lands, changing their names to make room for selections of his own. The latter also found Adélie Land, an immense tract situated far south of New Zealand and stretching for an unknown distance toward the Pole. The voyages of Wilkes (1838–42) and of Ross (1841–42) were of great importance, especially in their scientific aspects. Ross encountered land in 70° 41′ S. lat., 172° 30′ E. long., which had a steep, rocky coast-line; farther south in 77° 32′ S. lat., he found a lofty, active volcano which he named Mount Erebus and an inactive cone called Mount Terror. He sailed for a distance of 450 miles along an unknown ice barrier rising 150 feet above the water. During the next 30 years little was added to our knowledge of the Antarctic region. Dallman in 1873–74, however, visited many of the localities marked by previous explorers and was able to confirm their reports. The Challenger expedition, which started out in 1874, returned with proof of a floating ice barrier and also accomplished a vast amount of oceanographic investigation. More recently the expedition of Gerlache, who penetrated to lat. 71° 36′ S., was fruitful in scientific results and added over 100 islands to the list of those previously known. Borchgrevinck, a Norwegian, in charge of an English expedition, passed the winter of 1898–99 in the Antarctic and in the following summer reached lat. 78° 50′ S., the farthest then attained. In 1900 he set out again and succeeded in locating the south magnetic pole in lat. 73° 20′ S., long. 140° E.

From 1901 to 1912 Antarctic exploration was very active. Several expeditions were fitted out in 1901 and one of these under Capt. Robert F. Scott reached lat. 82° 17′, long. 163°, the farthest south. A Swedish expedition under Dr. Otto Nordenskjold, 1902–04, made many discoveries but lost its ship, the *Antarctic.* Other expeditions were under Dr. Erik von Drygalski (1902), W. S. Bruce (1904), Dr. Jean Charcot (1904), and Lieut. Ernest H. Shackleton (1907–09). In 1909–10 Dr. Jean Charcot on his vessel *Pourquoi Pas?* had a year of successful exploration, in which he found new lands, made new soundings and achieved other valuable scientific results. His work was mainly between the 69th and 71st parallels. In 1910 five expeditions were in the field: English, Capt. Robert F. Scott; Norwegian, Capt. Roald Amundsen; Australia, Dr. Douglas Mawson; Japanese, Lieutenant Shirhase; German, Lieut. William Filchner. Captain Scott sailed from New Zealand on his vessel *Terra Nova* 29 Nov. 1910, with the intention of establishing win-

ter headquarters at the foot of Mount Erebus and on King Edward VII Land. Captain Amundsen left Norway in the ship *From* in the summer of 1910 with the intention of rounding Cape Horn and entering upon the ice-drift across the Polar Sea which he had long contemplated. He changed his plans after sailing and when Captain Scott arrived at his proposed winter headquarters he found Amundsen already there.

Amundsen was finally successful in first locating the Pole. On his ship *From* he reached Hobert, Tasmania, 7 March 1912, on his return voyage and announced that he had discovered the South Pole 14 Dec. 1911. The winter of 1910–11 he spent in quarters in the Bay of Whales, 164° W., 78° 48′ S. On 10 Feb. 1911, he began to prepare for his winter's work and before 11 April had built caches as far south as 80°. The lowest winter temperature which he here recorded was on 13 August, minus 59° Celsius. The mean temperature for the year was minus 26° Celsius (14.8° below zero Fahrenheit). On 8 September, with eight men, 90 dogs and seven sledges, provisioned for four months, he started for the Pole, but only got as far as the depot at 80°. There the party remained until the middle of October when a fresh start was made with five men, 52 dogs, four sledges and four months' food. Victoria Land was reached 11 November. At 85° the land joins the Ross Barrier of ice and from that point the explorers had to climb through a region of land whose heights ranged from 2,000 to 11,000 feet high. In four days over the glaciers they reached a height of 10,600 feet, and their highest altitude, 10,750 feet, was attained on 6 December at 87° 40′. On 8 December at 88° 23′ they passed the farthest south record of Shackleton. From this point they found the going easy until on 14 December at 3 o'clock in the afternoon observations showed that they had attained their object. From 14 December to 17 December they remained at the Pole, taking observations and finally locating exactly 90° S. where they flew the Norwegian flag and named the land at the Pole King Haakon VII Plateau. Returning, winter quarters were reached 25 Jan. 1912. The principal results of the expedition were locating the Pole, determining the extent of the Ross Barrier, ascertaining the apparent connection of South Victoria Land and King Edward Land and the mountain ranges therein and the exploration of part of King Edward Land.

Thirty-five days after Amundsen had planted the flag of Norway at the South Pole, Capt. Robert F. Scott, R.N., unfurled the Union Jack of Great Britain, the exact points, as determined by observation, being not more than half a mile apart, and Scott took from the Amundsen tent the written message for King Haakon, which was subsequently delivered. Scott's southerly route had been practically that of his former discovery and of the Shackleton expedition and the return from the Pole was along the same track. Of the party of five, Petty Officer Edgar Evans was fatally injured soon after leaving the Pole and 11 miles from "One-ton" Camp, 155 miles from the Hut Point base in MacMurdo Sound, Scott, Dr. Edward A. Wilson, second in command, chief of the scientific staff, and Lieut. H. K. Bowers died in their tent of cold and privation. A few days before Capt. L. E. G. Oates of the Inniskillen dragoons, in desperate straits, bade his commander and comrades goodby, saying as he left them: "I shall be gone for some time," and upon a spot near may now be read the inscription:

"Hereabouts died a very gallant gentleman."

Not until the following spring (1913) did Surgeon Anderson succeed in reaching the tent of the dead and recovering the bodies of Captain Scott and his comrade, with records, collections and scientific data. The last entry in the journal contained:

"I do not regret this journey, which has shown that Englishmen can endure hardships, help one another and meet death with as great fortitude as ever in the past.

"These rough notes and our dead bodies must tell the tale, but surely, surely, a great rich country like ours will see that those who are dependent on us are properly provided for."

Sir Douglas Mawson, of Yorkshire birth, Australian training and education and professor in the University of Sydney, accomplished in 1911–14 a memorable Antarctic work of adventure and discovery. A member of the Shackleton expedition, he was of the party which successfully ascended the active volcano Erebus and penetrated to the floor of its crater and had demonstrated his fitness for field work and scientific research. Organizing a well-balanced party, competent in each branch of investigation, sustained by his government and contributions from scientific societies of Great Britain, the expedition on its leaving Sydney tarried for some time at Macquarie Island, upon which a party in charge of a wireless telegraph station was left, while the main body pushed on to a permanent base on Adélie Land. From this point work in every direction was diligently prosecuted, the coast line to the eastward being mapped and connected up with that of the Scott party in Ross Sea, while far to the westward a detachment under Capt. Frank Wild wintered, gathering valuable data. Sir Douglas himself at the head of an inland reconnaissance party accomplished one of the most difficult and perilous marches on record, losing in its early stages, through a crevasse, Lieutenant Ninnis, R.F., and later, through illness, Dr. Anton Merz, his two comrades, and narrowly escaping with his own life. A novel and interesting feature of the expedition was the maintenance, during a large portion of the time it was absent, of wireless communication with its Macquarie Island station, thence to Australia and the world, by means of which the news of the death of Captain Scott and disaster to his expedition was received. Sir Douglas' scientific work (in recognition of which and his exceptionally able conduct of it, and of his expedition, King George conferred upon him the order of knighthood) will require several years and a large amount of work for its complete and adequate publication.

The most ambitious and daring of all Antarctic projects was that of Sir Ernest Shackleton, launched in August 1914, after his offer of his services and that of his party to his country in the great war which had just broken out was declined. Sir Ernest's project contemplated a base on Coats Land and advance from that point directly over the ice barrier land mass and whatever might be met with to the South Pole, and thence keeping on to the familiar British Ross Sea base on the opposite side of the globe, employing for the purpose two ships,

two parties, each working in support of the other, though only that headed by himself was to make the complete transcontinental traverse. Leaving Liverpool, Sir Ernest proceeded in the *Endurance* via Buenos Aires and the Falkland Islands to South Georgia, whence the last word was that the ice conditions were so unfavorable that the attempt upon the main land must be deferred until the following season. More than a year passed when Sir Ernest again reported that though he had sighted new land he had been unable to reach it and compelled to abandon his main objective, the traverse of the great Antarctic land mass. The *Endurance* had been crushed and sunk and after a perilous journey over the pack, followed by one in boats across the open sea of nearly 1,000 miles, he had left his party of 22 marooned on Elephant Island, with a short supply of provisions. Sir Ernest himself with two comrades had crossed the distance between Elephant Island and South Georgia, landing upon it at the peril of his life, and after the loss of his boat had made his way over its interior to the Norwegian whaling station, whence his report was sent. Uruguay promptly placed a small vessel at Sir Ernest's disposal for the relief of his Elephant Island party, but the attempt was unsuccessful and at last a second and successful effort was made with a larger vessel under the Argentine flag. On the opposite side of the Antarctic continent results were equally unsatisfactory. The *Aurora*, having landed three parties to lay depots of food for Shackleton's advance, had been torn from her anchorage and for nearly a year adrift in the pack with her wireless equipment most of the time out of commission. Late in April 1916, however, a message from the ship was picked up in New Zealand, whence relief was promptly dispatched, and on 27 April Port Chalmers was finally made. See POLAR RESEARCH.

Antarctic Ocean.— The depths of the Antarctic Ocean have been explored in various parts by Ross, Wilkes, Nares (Challenger expedition) and Gerlache. Ross sounded in 4,000 fathoms in the vicinity of South Georgia without reaching bottom. The Challenger found depths of from 1,300 to 1,950 fathoms near the Antarctic Circle, south of Australia, while farther north the soundings ranged from 950 to 2,600 fathoms. Between the Cape of Good Hope and Kerguelen Islands depths of 2,500 to 3,100 fathoms have been reported. There seems to be a gradual shoaling of the waters toward the Pole, for Wilkes sounded in 500 to 800 fathoms off Adélie Land, and in 100 to 500 fathoms off Victoria Land, while Gerlache recorded less than 200 fathoms west of Palmer Land. The bottom in the extreme south is covered with a layer of diatom ooze. Farther northward the bottom is covered with deposits of globigerina ooze made up of the casts of *Foraminifera*, and in still deeper water the characteristic red clay, found at great depths in all the oceans, occurs. The temperature of the surface waters of the ocean range from a few degrees below to a few degrees above the freezing point.

Antarctic Continent.—The question whether there is a large land area of continental character within the Antarctic Circle has not yet been definitely settled, although most geographers and explorers express an affirmative opinion. Land areas of indefinite extent have been sighted and form an interrupted ring about the Pole. The mountain ranges and peaks discovered by Ross in Victoria Land are apparently of continental character. Granite and gneiss were found by D'Urville near Adélie Land, and Borchgrevinck states that the rock at Cape Adare is micaschist; these are distinctly continental types. Indirect evidence is furnished by the materials transported from the far south by the icebergs, sandstone, basalt, boulders of massive rocks, and fragments of gneiss, granite, diorite and sedimentary rocks. The great icebergs which drift far into the region of the Southern Ocean are difficult to account for on any other theory than that they have been broken off from a vast sheet of land ice like that covering Greenland.

Antarctic Ice.— The conditions of ice formation in the Antarctic differ materially from those of the Arctic region. In the northern hemisphere the polar ocean is enclosed by land, so that sea ice is much more important than land ice, the latter occurring only on the edge of the area, while in the Antarctic the reverse is true. Enormous masses of floating ice, flat-topped with perpendicular walls and oftentimes measuring many miles in width and length, are found throughout the Antarctic Ocean. The newly-formed bergs have evidently been broken off from the edge of a thick ice-cap covering the Antarctic lands and gradually pushed over the surface toward the sea. The thickness of the ice near the Pole is estimated by Croll upon theoretical grounds at from 12 to 14 miles, but off the coast of Victoria Land the ice-wall is only 10 to 20 feet high.

Climate.— The climatic conditions of the Antarctic are imperfectly understood, but temperature is extremely severe. Compared with the Arctic the region is placed at a disadvantage in having its summer during perihelion and winter in aphelion. Observations made by Ross in the vicinity of Victoria Land from 60° to 78° S. showed a mean summer temperature of 28.85° F. for the sea and 28.31° for air; in lat. 66° 29′ S. the maximum temperature in the month of December was 45.52° F. Wilkes found the mean temperature for January and February near Wilkes Land to be 30.2° F., with extremes of 34.52° and 23°, while Gerlache reported a winter minimum in 71° 30′ S. of —45°. The German station in South Georgia gave a mean temperature of 37.52°. The glaciation of the land areas, the great ice-floes and the saturated condition of the atmosphere, producing heavy fogs, are influential in producing the extreme cold. Barometric observations by Ross indicate a gradual increase in pressure south of 75° S., and it is believed that an area of extreme high pressure exists around the Pole, producing a permanent anticyclone with winds blowing in a southeasterly direction toward the higher latitudes. No estimate of the precipitation has been made, but the atmosphere is probably comparatively dry over the land areas in the extreme south and the precipitation is in the form of fine ice crystals. Farther north there is a heavy precipitation of snow and sleet; rain seldom falls within the ice-bound region.

Fauna and Flora.— The largest of the Ant-

arctic mammals are the whales which frequent the cold waters in great numbers. Many of the species are similar to if not identical with those inhabiting the Arctic seas; rorquals, humpback whales, pilot whales, grampuses and dolphins are known, also a small whalebone whale (*Balæna australis*), but the right whale does not exist in the Antarctic. There are 13 species of seals, including four of fur seals, which are closely related to those found in the north Pacific, the sea-lion and the sea-elephant. Among birds the penguins are most abundant, their rookeries being found on the borders of all lands free from ice. The largest species is the king penguin; a specimen captured by Wilkes measured 4 feet 6 inches in height and weighed 65 pounds. A gull-plover (*Chionis*) is found exclusively in the Antarctic. A small teal frequents Kerguelen, and stormy petrels, albatrosses, gulls, skuas and terns breed on most of the islands. Borchgrevinck found 11 species of fish in Antarctic waters, most of them new to science. Explorers have usually reported that fishes were scarce. A few species of insects have been described by Arctowski and Borchgrevinck. It is believed that no land animals exist in the extreme south. Of plant and invertebrate life inhabiting the Antarctic Ocean there is a great abundance. The pelagic animals include cephalopods, brachiopods and gastropods, which furnish food for the whales, cœlenterates and *Protozoa*. The deep-sea fauna is much more strongly developed than the shallow-water fauna living in the vicinity of the Antarctic lands. Thirteen species of phanerogamous and numerous cryptogamous plants have been found near South Georgia. Hooker obtained from Cockburn Island four species of marine algæ, three of fresh-water plants and 12 land plants, the last-named mostly lichens and mosses.

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HERBERT L. BRIDGMAN.

ANTARES, ăn-tā'rēz ("corresponding to Ares" or Mars, because assumed to be like Mars in color), or *Alpha Scorpii*, a red double star of the first magnitude, the middle one of three in the body of the constellation Scorpio; much used by sailors in ascertaining longitude.

ANT-BEAR, the great ant-eater, or tamanoir. See ANT-EATER.

ANT-BIRDS, a general term applicable to members of certain groups of birds within the *Formicariidæ* (q.v.), a South American group, all of which subsist largely upon ants. They have no proper oscine or singing organs, yet some of them have clear musical voices, and their notes of excitement when following the moving columns of destructive tropical ants, feeding not only upon them, but upon the insects they put to flight, are a warning which the natives understand and heed. All these birds are small and long-billed. The sub-family *Thamnophilinæ* is made up of the "ant-shrikes." The "ant-wrens" belong to the sub-family *Formicivorinæ;* and the "ant-thrushes" are a species of the *Formicariinæ*, a typical subfamily. The pitta is also sometimes improperly called an "ant-thrush."

ANT-EATER, a name given to several quite different mammals, but particularly applied to the *Myrmecophagidæ*, a South American family of *Edentata*, with the head extremely long; the snout slender; the mouth, ears and eyes small; the tongue long, cylindrical and covered with a viscid saliva which holds whatever insects are licked up until the tongue can be withdrawn into the mouth. When not in use the tongue lies doubled up in the mouth. The legs are strong and heavy; the toes vary in number in the different species, but in all species are united as far as the base of the large claws, which are adapted to digging, but are turned under the feet when the animal walks. The great ant-eater or ant-bear (*Myrmecophaga jubata*), found in tropical South America, is a sluggish animal, forest-dwelling, but entirely terrestrial; it grows to a height of two feet and a length of four feet, not including its long and very shaggy tail, which is often carried turned over its back like an umbrella. Though timid, it is capable of effective self-defense, using its strong forearms to hug and tear its opponents. Its body color is gray, set off by a black band which crosses the breast and tapers to the top of the shoulders, and by white feet and forelegs. The hair is long, particularly on the back toward the tail, and on the tail itself. It is very unsocial, spending much time asleep, curled up with its tail spread over it as a protection from sun or rain. As more than one is seldom produced at a birth, the great ant-eater is not numerous.

Another, much smaller, species (*Tamandua tetradactyla*), which is also tropical, is arboreal and has a prehensile tail. It is about the size of a cat; its head is broader in proportion than that of the great ant-eater; its hair is bristly and short, black on the body, yellowish white on the head, neck, forelegs and hindquarters. A third species (*Cycloturus didactylus*), the little or two-toed ant-eater, is still smaller than the tamandua and is also arboreal. Its claws are curved and very sharp for climbing, and its structure is peculiarly adapted for life in trees.

Besides the animals of this family, called the true ant-eaters, are their allies, the scaly ant-eaters or Manids (see MANIS), the aardvark, the porcupine ant-eaters (see ECHIDNA) and certain insectivorous marsupials found in Australia and belonging to the genus *Myrmecobius*. Certain birds, such as the *ant-shrike*, are also called ant-eaters (see ANTBIRDS).

ANTECEDENT STREAM. If folding or faulting occurs across the course of a stream slowly enough so that the river is able to cut down through the uplift as fast as it is formed, and the waters are not diverted, the stream is said to be antecedent. A well-known example is the course of the Kanawha where it crosses the Appalachian Plateau in West Virginia.

ANTEDILUVIAN («before the flood»), theologically referring to the period previous to the Deluge recorded in Genesis. Geologically a term now disused, meaning before the waters of the earth had transformed its surface into the present form by submergence, erosion, etc.

ANTELAMI, än'tä-lä'mē, **Benedetto,** Italian sculptor. He flourished from 1177 to 1233. He was the most prominent sculptor of the Romanesque epoch. His first work is a 'Descent from the Cross,' now in the cathedral of Parma. He served both as architect and sculptor of the cathedral of Parma, of which the sculptures on the façade, the holy-water font and the bishop's throne are from his hand. Other works by him are in the cathedral of Borgo San Donino and the portals of Sant' Andrea in Vercelli. Consult Venturi, 'Storia dell' arte italiana' (1907).

ANTELOPE (Greek, *antholops,* a horned animal), an animal of the sub-family *Antilopinæ,* placed between the cattle and the goats in the family *Bovidæ.* Its members are all short-haired, lightly and gracefully built and carry their heads uplifted; in size they vary from that of a kid to the height of a tall horse, and almost all are timid and fleet-footed. Popularly, the antelopes include such widely varying species as the goat-antelopes (the chamois and the Rocky Mountain goat) at one extreme, and at the other the American prong-horn which has branched deciduous horns; but scientifically both these extreme forms must be excluded, and the term confined to Asian and African species having horns present in both sexes, the cores of which are solid, and which tend to grow upward rather than outward.

Antelopes have been pronounced the most generalized of the living *Bovidæ,* and consequently are regarded as representing the form from which the other types within the family have descended. Their earliest fossil remains are found in the Miocene, when they flourished all over Europe and Asia, and their migration into Africa seems to have been comparatively recent. When Africa was first explored by Europeans, however, they were established there and had so enormously multiplied as to be the chief resource for meat of the natives and of carnivorous animals. Colonization so wasted and scattered them, however, during the latter part of the 19th century, that some species are already extinct, and others would be except for preservation on private estates.

Antelopes may be ranged in certain groups, such as the antelopine gazelles, including many species which are beautiful in form but do not often exceed 30 inches in height, with goat-like teeth, hairy muzzles and ringed horns, usually either spiral or lyre-shaped. This group inhabits deserts from the Cape of Good Hope in India, and among them are the ariel and other gazelles, the springbok, the black-buck of India, the saiga and various others. Another, the cervicaprine group, contains the little African reedbuck, the small klipspringer and rehbok, the tiny steinbok and the larger waterbucks, etc. A third group comprises several African forest-ranging species, among others the pygmy antelope, only 13 inches tall and the smallest known ruminant. Another group is far larger and has many of the characteristics of cattle, while still another section diverges toward the goats. The largest, most beautiful and valuable group of all is that which contains the Indian nilgai and the African bushbuck and eland.

There is an erroneous notion abroad that antelopes all live in large bands, or even vast herds, that roam over flat plains and perform migrations in large bodies from one place to another as scarcity of food and the weather compel them. Instead of this uniformity, however, there exists great variety in size, shape, color, speed, agility and habits in adaptation to the varied circumstances in which they live. Some dwell altogether in mountains and are as expert in climbing about the rocks as are the goats. Others frequent forests and rarely leave their shade. Still others remain entirely among hills where dense thickets cover the rough surface and dart in and out among the bushes so rapidly and expertly that the sportsman finds the greatest difficulty in getting a shot at them. Aquatic antelopes exist, especially in south Africa, where certain kinds, as for example, the reedbucks, spend nearly all their time in marshes, wading and swimming about and feeding upon aquatic vegetation. It is indeed only the larger, stronger and better armed kinds that can endure existence in plains where they have little means of protection against leopards, lions and other enemies, and must trust entirely to escape by flight or by being overlooked. The result has been the development among them of great speed, but this has not been accompanied by endurance, since few are required or are able to continue to run swiftly any great distance. As an aid to their safety, nature has developed in the desert- and plain-dwelling species an adaptation in color to their surroundings, making them almost invisible when lying down or standing against the rock and thicket. As a rule their coats have the dull colors of a plains landscape, the only somewhat conspicuous markings being those upon the face and tail, which serve the purpose of «recognition marks» but are not sufficiently large to attract attention at any great distance. Sometimes this protective color of antelopes is very striking, as in the case of the red hartbeest of east Africa, which frequents the open country where the soil is rust-red and termite hills are exceedingly numerous. It is said that the most experienced hunters are constantly deceived by the exact resemblance between one of these antelopes when lying down and an ant-hill.

The flesh of most antelopes is regarded as excellent food and some of them yield meat that is most delicate eating. The hides of the larger ones make good leather, and the destruction which has overtaken the race in South Africa has been brought about mainly by hide-hunters. The horns were put to many uses by the native Africans and Asiatics and are still in demand for the making of fancy handles and other articles of ornament.

For additional information see BLACKBUCK; GAZELLE; GNU; HARTBEEST; PRONGBUCK and other names of groups and species in this family. Consult also the general natural histories; Schmidt, 'Mammalia' (New York 1886); Flower and Lydekker, 'Mammals, Living and Extinct' (London 1891); Sclater and Thomas, 'Book of Antelopes' (4 vols., qto.,

col. plates, London 1894–1900); Beddard, 'Mammalia' (New York 1902); Ingersoll, 'Life of Mammals' (New York 1906).

ANTHELIA, luminous rings opposite to the sun, seen when the observer looks toward his own shadow cast upon a cloud or fog bank or on the dewdrops on the grass. The shadow is observed encircled by one or several concentric rings, with the common centre at the anti-solar point. They are attributed to diffraction or interference, are usually colored, red inside and blue without. The radius of the rings increases with the smallness of the globules that make up the fog or cloud. Consult Pernter 'Meteorologische Optik' (Vienna 1901). See LIGHT.

ANTHELMINTIC, medicine hostile to intestinal parasites. They are divided into two classes, vermicides, those which destroy; and vermifuges, those which expel. They are administered after a period of fasting, so that the worms will not be protected by masses of food, and are followed within a few hours by a purgative to expel the dead or stupefied parasites. See HOOKWORM; TAPEWORM.

ANTHER, the part of a stamen which produces pollen. Usually it consists of two diminutive sacs, separated by a certain amount of sterile tissue, which is often merely the top of the axis of the stamen. See FLOWER.

ANTHERIDIUM, the male organ of plants, in which the sperms are developed. In some plants it is a single cell; in others, a many-celled organ of varying shape. The antheridium bursts open in the presence of moisture, frees its mass of sperms, which then swim to the female organs. In seed-plants the organ is concealed, while in the lower groups it is conspicuous.

ANTHOLOGY ("nosegay"), a name originally given to a collection of short unconnected Greek poems from many sources, and till lately applied only to that and its various enlargements. In recent times it has been extended to any collection of detached pieces of miscellaneous authorship, prose or verse, to represent a language, a literature, a country, an epoch or any sort of subjective idea as a thread on which to group it. See GREEK ANTHOLOGY, THE; LATIN ANTHOLOGY, THE.

ANTHON, Charles, an American educator: b. New York city, 17 Nov. 1797; d. there, 29 July 1867. He was graduated at Columbia College in 1815 and admitted to the bar in 1819, but never practised. He was adjunct professor of Greek and Latin at Columbia 1820–30, and full professor and head master of the grammar school connected with the college 1830–64. In 1835, in connection with the Harper publishing house, he projected a 'Classical Series' to include works used in academies, preparatory schools and colleges. It proved the most successful enterprise of its kind ever undertaken in America. Of the more than 50 volumes edited by Anthon the following are the best known: An edition of Lemprière's 'Classical Dictionary' (1822); 'Horace' (with notes, 1830); 'Dictionary of Greek and Roman Antiquities' (1843); 'Classical Dictionary' (1841).

ANTHONY, Alfred Williams, American clergyman: b. Providence, R. I., 13 Jan. 1860. He was graduated from Brown University and Cobb Divinity School. He also studied two years in Berlin. In 1885 he entered the pastorate of the Free Baptist Church and became pastor of the Essex Street Church of Bangor. From 1890 to 1908 he was professor of New Testament Exegesis in the Cobb Divinity School; 1908 to 1911 professor of Christian literature and ethics in Bates College. Since 1911 he has been the corresponding secretary and treasurer of the General Conference of the Free Baptists. He is author of 'An Introduction to the Life of Jesus' (1896); 'The Method of Jesus' (1899); 'The Sunday School — Its Progress in Method and Scope' (1899); 'Preachers and Preaching' (1900); 'The Higher Criticism in the New Testament' (1901); 'New Wine Skins' (1901).

ANTHONY, ăn'tō-nĭ, Clemens Theodor: b. 1755; d. 1836. King of Saxony, who succeeded his brother Frederich August I, 5 May 1827. The French revolutionary movement of 1830, spreading to Saxony, compelled him to grant a constitutional government in 1831.

ANTHONY, Henry Bowen, American legislator: b. Coventry, R. I., 1815; d. 1889. He was graduated from Brown University in 1833 and was editor of the Providence *Journal* for over 20 years. He was governor of Rhode Island in 1849 and 1850, and United States Senator from 1859 till his death.

ANTHONY, John Gould, American naturalist: b. Providence, R. I., 17 May 1804; d. Cambridge, Mass., 16 Oct. 1877. Leaving school at 12 years of age he followed a business career for 35 years. He early developed a taste for natural history, and his publications attracted the attention of Agassiz, through whom in 1863 he became head of the conchological department of the Museum of Comparative Zoology, a post he held until his death. He was a recognized authority on the subject of American *Mollusca.*

ANTHONY OF PADUA, Saint: b. Lisbon, 15 Aug. 1195; d. Padua, 13 June 1231. Shortly after his ordination to the priesthood he was deeply stirred by the recital of the cruel martyrdom of five Franciscan missionaries whose bodies had just been brought from Morocco to Coimbra, where Anthony was then living. Having entered the Franciscan order, he soon started for Africa in the hope of being permitted to die for Christ. He had scarcely landed when illness obliged him to leave. Hearing about the general council of his order which was going on, he started for Assisi, where he met Saint Francis, the founder of the order. His profound knowledge of sacred things, joined to his sanctity, caused him to be made the first teacher in the Franciscan order and later on the provincial of all the convents of the order in upper Italy. His feast is celebrated 13 June. Consult Coleridge, S. J., 'Life and Works'; Meyer, 'Leben des H. Antonius'; Lepitre, 'Saint Anthony of Padua,' translated by E. Guest (1903).

ANTHONY, Saint, the patriarch of monastic institutions: b. near Heraclea, in Upper Egypt, 251 A.D.; d. 356. Giving up all his property, he retired to the desert, where he was

followed by a number of disciples, who thus formed the first community of monks.

ANTHONY, Saint, Cross of, a cross in the shape of the letter T, often styled the Tau Cross. In heraldry the name is given to two stripes, a horizontal and a vertical one crossing in the middle of the escutcheon.

ANTHONY, Saint, Falls of, a noted fall in the Mississippi River, within the limits of Minneapolis, Minn. (q.v.) The entire descent of the stream for three-quarters of a mile is 65 feet. The falls and surrounding scenery are exceedingly picturesque.

ANTHONY, Saint, Fire of, a name now applied to a form of erysipelas. A distemper of this character became epidemic in France in 1089. Many miraculous cures having been effected by the imputed intercession of Saint Anthony, the order of Canons Regular of Saint Anthony was founded the next year for the relief of those afflicted with this disease. The order continued to exist till 1790.

ANTHONY, Sister, American nurse and nun, known before entering religious life as Mary O'Connell: b. Limerick, Ireland, 15 Aug. 1815; d. Cumminsville, Cincinnati, Ohio, 18 Dec. 1897. She came with her parents to this country in childhood and in 1835 entered the order of Sisters of Charity at Emmittsburg, Md., removing to Cincinnati in 1837, there to take charge of work in Saint Peter's Orphan Asylum. On the establishment of Saint Joseph's Orphan Asylum at Cumminsville, in 1854, Sister Anthony was placed in charge and the next year she was transferred to Saint John's Hospital, where she remained 10 years. The terrible slaughter at the battle of Pittsburgh Landing appealed so strongly to her sympathies that with two companions she accompanied the noted surgeon, George C. Blackman, to Nashville to minister to the wounded there winning her title of "The Angel of the Battlefield." She returned to Cincinnati on a hospital steamer with many wounded soldiers whom she cared for at Saint John's Hospital. In 1866 two prominent Protestant business men of Cincinnati purchased the United States Marine Hospital and transferred it to the Sisters of Charity in the hands of Sister Anthony. The name was then changed to "The Good Samaritan," and she remained in charge till 1882. Not only was she in charge of various institutions of her order, but was several times procuratrix of the community. She is buried at the mother house of Mount Saint Joseph and her grave is annually strewn with flowers on Memorial Day by the soldiers of the Grand Army of the Republic.

ANTHONY, Susan Brownell, American reformer: b. South Adams, Mass., 15 Feb. 1820; d. Rochester, N. Y., 13 March 1906. She taught school in New York in 1835–50, in 1852 assisted in organizing the Woman's New York State Temperance Society, and in 1854–55 held conventions in each county in New York, in behalf of female suffrage. In 1857 she became a leader in the anti-slavery movement, and in 1858 advocated the coeducation of the sexes. She was influential in securing the passage by the New York legislature, in 1860, of the act giving married women the possession of their earnings and guardianship of their children. In 1868, with Mrs. E. C. Stanton and Parker Pillsbury, she began the publication of the *Revolutionist,* a paper devoted to the emancipation of woman. In 1872 she cast ballots at the State and Congressional election in Rochester, N. Y., to test the application of the 14th and 15th Amendments of the United States Constitution. She was indicted for illegal voting and fined, but the fine was never exacted. Her last public appearance of note was as a delegate to the International Council of Women, in London, England, in 1899. In 1900 her birthday was celebrated by an affecting popular demonstration in Washington, D. C., and she retired from the presidency of the National American Woman Suffrage Association, which she had held for many years. Consult 'Life and Work of Susan B. Anthony' (1898).

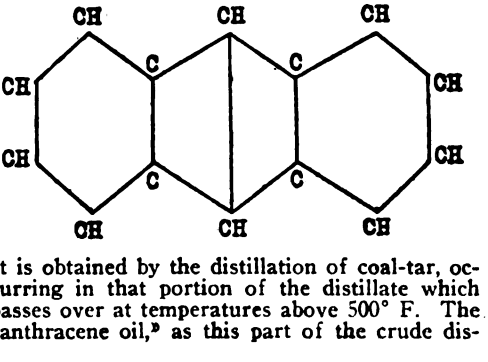
ANTHONY, William Arnold, an American physicist: b. Coventry, R. I., 17 Nov. 1835; d. 29 May 1908. He was graduated from Yale Scientific School 1860 and taught science in various secondary schools 1860–67. He held chairs of physics and chemistry in Antioch College and Iowa Agricultural College 1869–72, was professor of physics at Cornell 1872–87, and consulting electrician, Manchester, Conn., 1887–93. From 1893 till his death he was professor of physics in Cooper Union School of Science. He contributed many papers to the volumes of the scientific societies of which he was a member.

ANTHONY, Kan., city and county-seat of Harper County, 55 miles southwest of Wichita, on the Atchison, Topeka and Santa Fe, the Chicago, Rock Island and Pacific, the Missouri Pacific and other railroads. It contains a flour mill, an ice plant, a salt plant, and has extensive stock raising and agricultural interests. The principal buildings are the Carnegie library, opera house, two hospitals and seven churches. The city is under the commission form of government, and owns the electric and water systems. Pop. 2,669.

ANTHOSIDERITE, ăn-thŏ-sīd'ĕr-īt (from the Greek *anthos,* "a flower," and *siderites,* "iron"), a mineral related to chloropal, occurring in fibrous tufts and sometimes in feathery forms resembling flowers. It is harder and heavier than chloropal, is usually yellowish in color, and has the composition $2Fe_2O_3.9SiO_2.2H_2O$. It is found in Brazil.

ANTHOZOA. See ACTINOZOA.

ANTHRACENE (from *anthrax,* or *anthrac-,* "coal"), a hydrocarbon having the chemical formula $C_{14}H_{10}$, and the molecular structure



It is obtained by the distillation of coal-tar, occurring in that portion of the distillate which passes over at temperatures above 500° F. The "anthracene oil," as this part of the crude dis-

tillate is called, is allowed to stand in the cold for a week or so, until the greater part of the anthracene has crystallized out. The solidified portion when freed from the mother-liquor by pressure or by a centrifugal separator is ground up and washed with petroleum spirit to remove as much as practicable of the paraffin and other impurities. Anthracene so obtained is then sublimed and placed on the market as "50 per cent anthracene," although it may contain as much as 65 per cent of the pure substance. Its precise strength is best determined by treating a known weight with boiling glacial acetic acid and chromium trioxide, and observing the quantity of anthra-quinone that is formed. The crude anthracene of commerce may be further purified by distillation with caustic potash to which a little caustic lime has been added. Most of the impurities are removed in this way, and the product is further improved by subsequent washing with petroleum spirit, or with carbon disulphide, and finally by recrystallization from a hot mixture of benzene and aniline. Pure anthracene crystallizes in white, monoclinic tablets melting at 415° F., and boiling at about 680°. It is insoluble in water and dissolves but slightly in other common solvents. It is soluble, however, in boiling glacial acetic acid, and also in hot benzene. It is used in large quantities for the manufacture of alizarin (q.v.) Anthracene is changed, by the action of sunlight, into an isomeric substance known as paraanthracene (or paranthracene), which melts at 472° F., and is reconverted into anthracene by fusion. See also COAL-TAR COLORS.

ANTHRACITE, a variety of coal distinguished from other coals by its high proportion of carbon and small quantity of volatile matter. It has a conchoidal fracture, bright lustre, dense black color and superior hardness. The percentage of carbon is variable, ranging from a minimum of about 80 per cent to a maximum of 95 per cent. Anthracite grades by imperceptible stages into bituminous coal, from which it has been produced by the action of heat or intense pressure. Semi-anthracite and semi-bituminous are intermediate grades. The coal-seams of eastern Pennsylvania are included in a series of strata which have been compressed and thrown into folds, while westward in the bituminous fields of Pennsylvania and Ohio the strata lie nearly horizontal. Beds of bituminous coal are frequently observed to grade into anthracite in the vicinity of igneous intrusions, as at Crested Butte, Colo., and near Sante Fé, N. M. Where the heat has been very intense, however, the volatile matter is entirely driven off and graphite is formed.

Anthracite occurs in extensive deposits in many parts of the world. The most productive deposits are those of eastern Pennsylvania which occur in several detached fields, located as follows: The Northern field, extending through the middle of Luzerne and Lackawanna counties; the Eastern Middle, between the Lehigh River and Catawissa Creek; the Western Middle, between the eastern headwaters of the Little Schuylkill River and the Susquehanna; and the Southern, or Pottsville, field, extending from the Lehigh River at Mauch Chunk southwest to near the Susquehanna River. These fields comprise an area of 472 square miles and are classed under three general divisions, namely, Wyoming, Lehigh and Schuylkill regions. The Bernice field in Sullivan County produces a semi-anthracite coal and is sometimes included with the anthracite fields. The strata with the beds of coal have been upturned and the outcropping edges subjected to long-continued erosion. The most important and persistent seam is the Mammoth, which in the Eastern Middle field has a thickness of from 60 to 90 feet and is over 100 feet thick in parts of the Southern and Western Middle fields. Altogether the workable seams number 15 or more, with a total thickness (increasing from west to east) ranging from 70 to 150 feet. The anthracite fields of Colorado and New Mexico are of much less importance. In foreign countries anthracite is mined in South Wales, Ireland, Belgium, France, Westphalia and Russia, and it is known to occur in very large deposits in the province of Shan-Si, China. In the south Wales field only the northern portion yields anthracite, the rest of the output being semi-bituminous and bituminous coals.

Owing to its cleanliness and freedom from smoke anthracite is especially suited for household fuel; for steaming and metallurgical purposes it is inferior to bituminous coal. It ignites with difficulty and burns slowly with little flame, giving out intense heat. The amount of ash is small, ranging from 15 per cent to 6 or 7 per cent. The color of the ash is sometimes used as a basis of classification in trade, as in Pennsylvania anthracites, which are denominated white-ash and red-ash coals. But the color depends entirely upon the amount of iron present and is no criterion of the value. The following analyses show the relative proportions of fixed carbon, volatile matter, ash, etc., in various anthracites:

Fields	Fixed carbon	Volatile matter	Water	Sulphur	Ash
Eastern Middle, Pa..	86.38	3.08	4.12	1.62	5.92
Southern, Pa.....	83.81	4.27	3.09	0.64	8.18
Crested Butte, Colo..	82.33	9.96	0.81	0.81	6.90
South Wales.....	92.42	5.97	....	....	1.60

The preparation of anthracite for the market consists in freeing it from slate and dust and sorting it into suitable sizes. Owing to the practical absence of volatile matter, anthracite will not burn unless the lumps are of fairly uniform size. When hoisted from the mine it is first passed over a screen which allows most of the fine coal to pass through. The lump coal is then sorted for the purpose of removing the shale and slate, and the pure material is crushed between rolls and screened into the market sizes. In the United States the sizes generally recognized are the following: Broken or grate, which passes through a screen of 4-inch mesh but not through 2.5-inch mesh; egg, 2.5-inch–1.75-inch; stove, 1.75-inch–1.25-inch chestnut, 1.25-inch–0.75-inch; pea, 0.75-inch–0.50-inch; and buckwheat, 0.50-inch–0.25-inch. Larger sizes than the above are known as lump and steamboat, and smaller sizes as rice, mustard-seed, etc. The sizes from broken to chestnut, inclusive, are known as the domestic prepared sizes and constitute at present about 60 per cent of the output. The waste or fine coal which commonly amounts to as much as 10 per cent of the material mined is known as culm. Immense heaps of this fine coal have accumulated at the

mines, but with the improved processes of screening and separation much of it is now saved and sold to manufacturing plants.

The growth of the anthracite mining industry in the United States has been very rapid. There are records showing that Pennsylvania anthracite was used for fuel as early as 1768, but mining was not carried on to any extent until about 1820. The growth of the industry from this time to the close of the century is shown in the following table:

	Short tons		Short tons
1820	365	1870	15,664,275
1830	215,272	1880	28,649,812
1840	967,108	1890	46,468,641
1850	4,138,164	1900	57,367,915
1860	8,115,842	1910	84,485,236

The production and value of Pennsylvania anthracite during the period 1911–15 were as follows:

	Production short tons	Value
1911	90,464,067	*$175,500,000
1912	84,361,598	178,000,000
1913	91,524,922	194,948,000
1914	90,821,507	188,000,000
1915	88,500,000	.....

Almost the entire output of anthracite is consumed as domestic fuel. A small portion is used for manufacturing purposes in large cities, but it is being gradually superseded for this purpose by the cheaper bituminous coal. See COAL.

ANTHRAC'NOSE, a group of fungous diseases caused by various species of *Glœosporium* and *Colletotrichum,* which appear upon the green parts of plants as roundish spots with more or less sunken light centres and darker margins. They often cause serious damage to cultivated crops, especially grape, strawberry, raspberry, spinach, egg-plant, cotton and cucumber, under which titles they will be more fully discussed. For methods of control see FUNGICIDE.

AN'THRACOTHER'IUM, an extinct pig-like animal, inhabiting Europe and North America during the Oligocene and Miocene epochs. The teeth are intermediate between those of pigs and ruminants, but it is not in the direct line of descent of either, forming a side branch which left no descendants. The name, given by Cuvier in 1822, means "beast of the coal" (*ἄνθραξ*, coal, *θηρίον*, beast), and is derived from the fact that its remains were first discovered in the Tertiary lignite beds of France.

ANTHRAQUINONE, ăn'thra-quĭn-ōn' (from *anthra-cene* + *quinone*), a substance derived from anthracene by the action of oxidizing agents, and used in the preparation of alizarin. It may be conveniently prepared on a small scale by dissolving anthracene in glacial acetic acid, adding potassium bichromate and heating to 212° F. The acetic acid is then distilled off, and the anthraquinone precipitated by water. On the large scale sulphuric acid is used in the place of acetic acid. Anthraquinone has the formula $C_{14}H_8O_2$, and is insoluble (or nearly so) in water and alcohol, and but slightly soluble in benzene. It dissolves in hot sulphuric acid, separating out again, without change, upon cooling.

ANTHRAX, the name of a disease occurring epidemically among herbivora, chiefly oxen and sheep, and occasionally affecting man. It is also called malignant pustule, splenic fever, wool-sorters' disease, charbon, milzbrand. It is caused by a rod-shaped bacterium, the *Bacillus anthracis,* first seen in 1849 and isolated in 1863, and conclusively proved by Koch in 1876 to be the cause of the disease, this being one of the first diseases demonstrated to be caused by bacteria.

In man the bacillus is usually acquired by handling the hide of an animal having died from the disease. A local lesion, the malignant pustule, is formed, and this may lead to widespread infection with œdema and lymphatic invasion, attended by fever, gastro-enteritis, collapse, and death. The infection may remain localized, however, and the patient may recover. Less often the infection takes place in the respiratory tract, the patient having breathed the bacillus in the dust arising from handling hides or sorting wool; in such cases a rapidly fatal form of hæmorrhagic œdema may develop. A still rarer form of the disease in man affects the intestinal tract. The bacillus of anthrax is one of the largest of the pathogenic bacteria. It is 6-8 microns $\left\{\frac{6\text{-}8}{25{,}000}\right\}$ inches long and 1.5 microns thick, being a short rod with square edges, and growing in chains. The protoplasm is finely granulated and it forms spores about the centre of the bacillus. It grows very rapidly on all of the commonly used bacteriological culture media, best at a temperature of 35° C., but its multiplication ceases at temperatures below 12° C. or above 45° C. The bacilli are readily killed by temperatures of 60° C., but the spores are very resistant, and dry heat at 140° C. must be applied for several hours to kill them. In a dry condition they remain viable for several years and will resist boiling water for at least five minutes. The gastric juice also does not destroy them readily. The bacteria are found in the blood and throughout the organs of animals dying of anthrax. They are particularly numerous in the spleen and in the lymphatic structures. They poison the body by the development of a toxin or toxins which in turn cause degeneration of the tissues of the body.

Anthrax is one of the diseases in which a serum therapy was instituted early. Thus far it has not proved of signal service, although a protective serum has been made by which animals may be immunized against the disease.

Anthrax in animals is a comparatively common disease, affecting sheep, cattle and, more rarely, horses and members of the deer family. It is rare among the carnivora. The disease is not geographically confined, and animals in various parts of the world are affected by it. It is naturally less common in countries in which there is some legislative control, and rarer at present than in former times. In Britain the mortality is small; in France, at one time, as many as 10 per cent of the sheep died annually of anthrax. Since the modern method of im-

*Based on average of pieces of all grades and sizes at the mines.

munizing cattle has been introduced the mortality has been much lessened. The symptoms vary widely, but at least three marked groups are observable. In some instances the affected animal develops symptoms of extreme collapse; it drops to the ground; the pulse and respiration are quickened, there is difficulty in breathing and the animal dies in convulsions within a comparatively short time. A commoner type of attack is begun by symptoms of general distress, the animal is "off its feed," the pulse and respiration are quickened, chills develop, the temperature rises to 103 or 104° F., bloody diarrhœa occurs, bloody nasal catarrh. There then may develop convulsive movements; there is rapid loss of strength, and the animal may die in from 10 to 48 hours, sometimes at the end of three to four days. A third type is characterized by a slow onset, the lymphatic structures are involved, they swell and form carbuncles, which may ulcerate. General symptoms of infection may develop — the spleen may enlarge, bloody discharges are common and the animal dies of generalized hæmorrhagic œdema. The diagnosis is readily made in all cases by a microscopical examination of the blood. Different animals show marked variations in susceptibility. The sheep, save Algerian, ox, guinea-pig and mouse, are all very susceptible, but the goat, horse, deer and pig are less often attacked. Man may be placed next in the order of liability; the white rat, adult carnivora, birds and amphibia are immune. The disease is conveyed to animals largely by way of the intestinal canal. The bacilli are ubiquitous in the grass and hay about an infected area.

Preventive Inoculation.— Pasteur first evolved a method of inoculation by an attenuated virus, a sort of hardening the animal, as it were, that subsequently made it resistant to the virile bacteria. Although other methods, notably the use of anti-anthrax serum, have been used, the attenuated virus method seems to give the best results. Surgical methods are the only mode of treatment for man. Thorough sterilization of hair, wool and animal skins by dry heat, steam or by chemical agents is now generally adopted to prevent the infection of man from these sources.

Pasteur's method was the injection of a culture attenuated by 24 days' growth at a temperature of 42.5 C., followed in 10 days by an injection of a culture attenuated by a growth of but 12 days at the same temperature. The Dawson method, invented in 1911, is the injection of a single vaccine, differing from that of Pasteur only in degree of attenuation. It is used when animals are dying from the disease and immediate protection is required. A passive immunity lasting from one to two weeks is thus secured within a few hours.

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AN'THRENUS. See CARPET BEETLE.

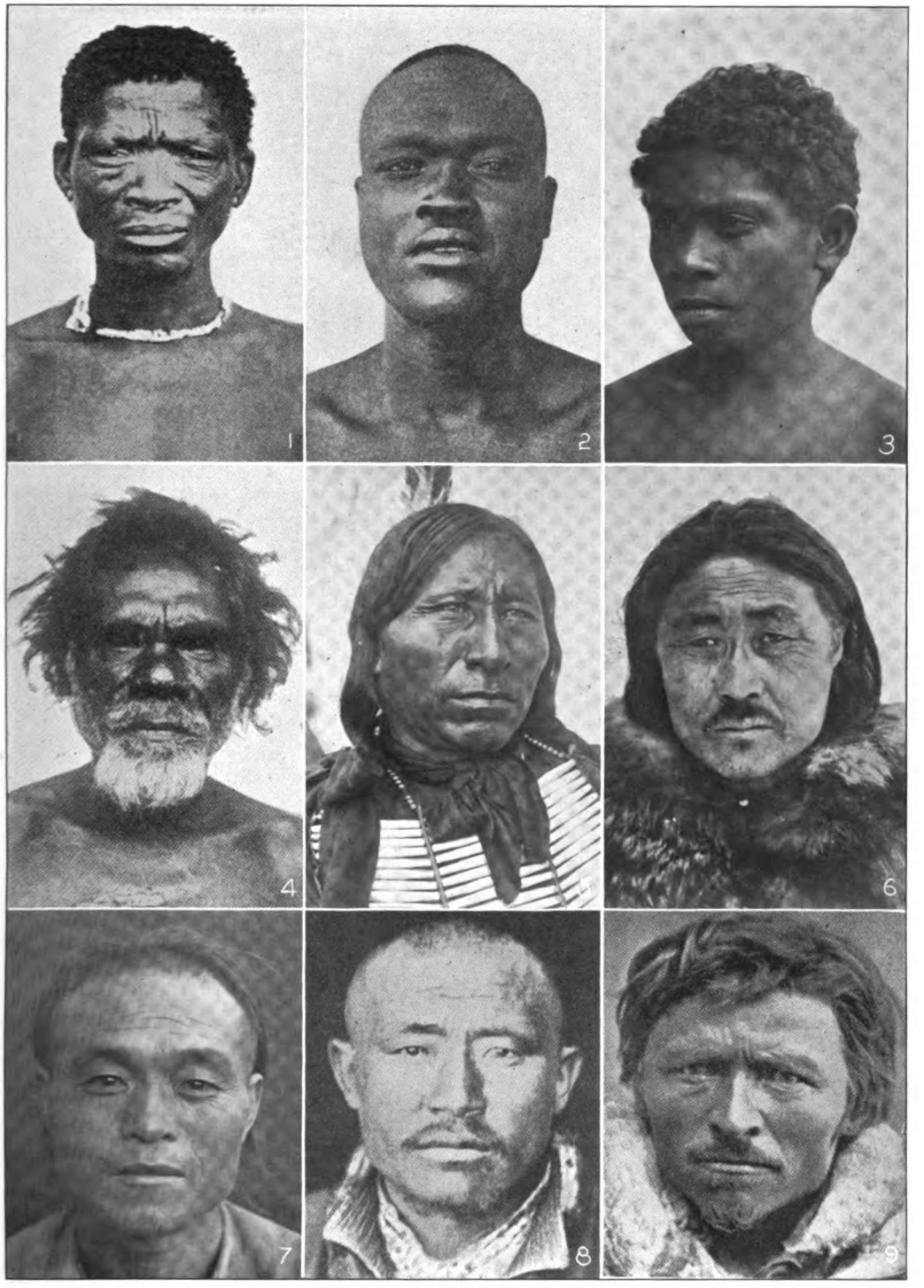
ANTHROPOID APES, a term applied to those apes (family *Simiidæ*) nearest in their organization to man. See APE.

AN'THROPOL'ATRY, the worship of man, a term always employed in reproach. It was applied by the Apollinarians to the orthodox Christians of the 4th and 5th centuries, who in their devotion to Christ worshipped, as was declared, only a man in whom God dwelt.

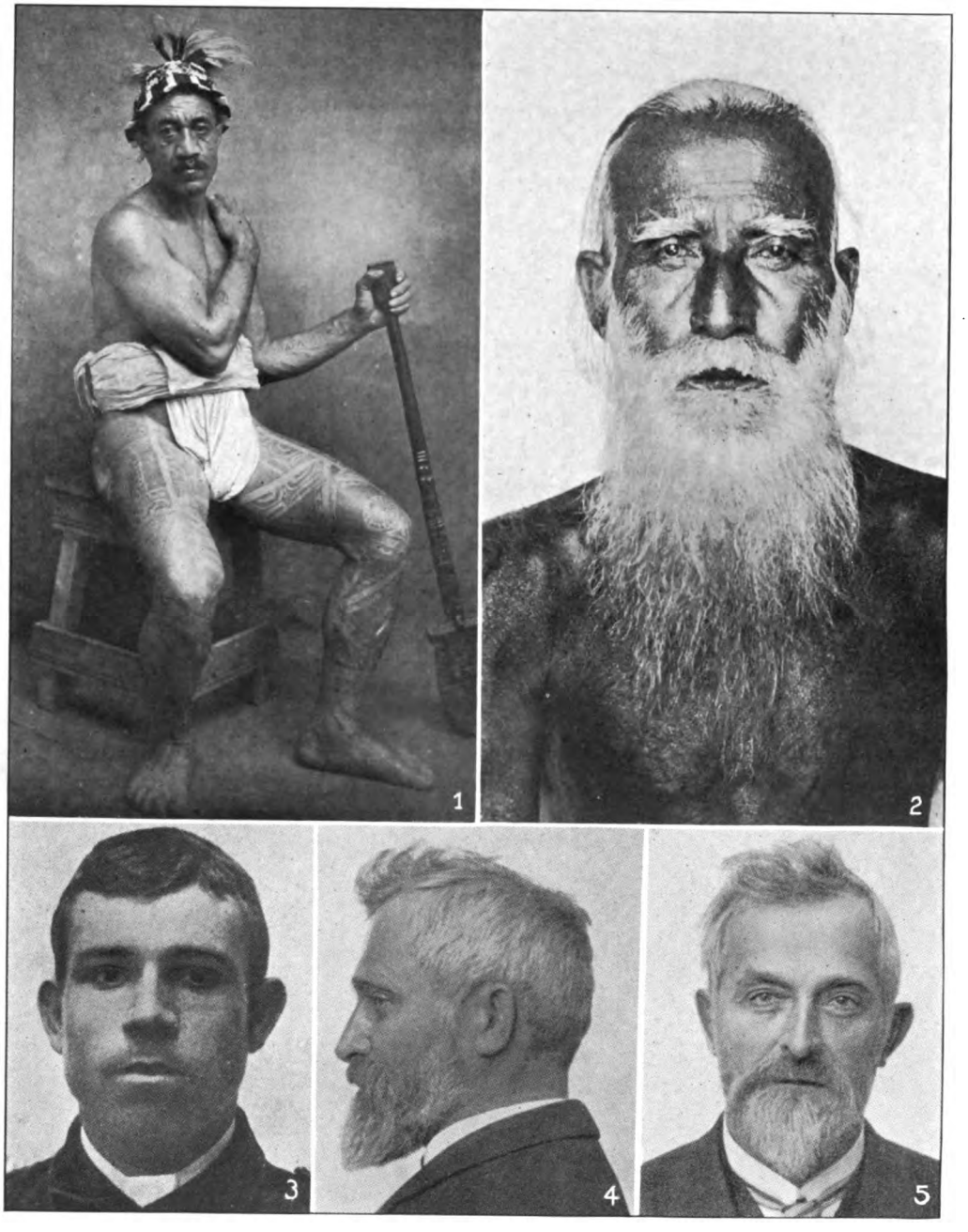
ANTHROPOLOGY. Anthropology is the name for a group of problems arising from inquiries as to man's origin. As used in the United States and England this name stands for the science that deals with these problems, but on the continent of Europe the tendency is to restrict the term anthropology to a study of man's body, particularly his bones. This, like most other facts of this kind, has an historical explanation. Thus, the study of anthropology really begins with Blumenbach (1752–1840) of Göttingen, Germany, who conceived of classifying skulls according to form and measurement. While it is true that this idea was in a way entertained by Vesalius, Linnæus and other pioneers, nevertheless it was Blumenbach who first struck the keynote of classification according to form and dimensions of the human skull. Following him were Retzius who devised the cephalic index, Camper who invented the facial angle, and, finally, the great French anthropologists Broca and Topinard who systematized the subject. It will be noted that so far anthropology dealt almost exclusively with man's anatomy, whereas at present it gives even more attention to his modes of life, or his culture.

While the above interest in man's anatomical attributes was taking form other students began to systematize the available knowledge concerning the habits and customs of different peoples. To this study the name ethnology is often applied. The great leaders of this movement were Tylor (England), Ratzel (Germany) and Reclus (France). The published works of these men dealt exclusively with the social life of man and his distribution over the earth and in so far were distinct from the anthropology of the day. From some points of view these two subjects, ethnology and anthropology, as then defined, had little in common and indeed the tendency in Germany and other continental countries is to so regard them still; but the great synthetizing work of Prichard (1786–1848) in England gave a new unity to the whole study of man. According to this author, man should be classified according to all definitive characters: anatomy, psychology, geographical distribution, and habits. Since man's zoological characters were regarded as the pivotal point in his development, the term anthropology was applied to this new synthetic whole. This thenceforth became the ideal for English students of man — to deal synthetically with all the data available bearing upon the problems of man's origin and early career. In the main, American anthropologists have followed the English in this respect.

ANTHROPOLOGY



1 Maori (Australian-African)
2 Zulu (Australian-African)
3 Filipino (Australian-African)
4 Bushman (Australian-African)
5 Indian-(Asian American)
6 Siberian-(Asian American)
7 Northern Mongol
8 Eskimo (Asian-American)
9 Laplander (Asian-American)



THE POLYNESIAN — EUROPEAN GROUP.

1 Tahitian — Polynesia
2 Singhalese — India
3 South European (Dark)
4–5 North European (Light)

We can define anthropology, therefore, as the natural history of man, or the science which begins where history leaves off, and which seeks to recover the story of man's origin and varying fortunes in that dim and shadowy era we call the prehistoric. The limitations that must be imposed upon this general statement will be more apparent when we summarize the content of our subject.

The anthropology of any group of people now deals with three great classes of characters: the somatic, linguistic, and cultural.

Somatic Characters.— One of the great problems under this head is to know man's zoological position among mammals. The classification of existing men is the great prerequisite to such investigations. Though as a mere proposition this seems a small task, it proves to be one of very great difficulty, so difficult that even now there is no generally accepted classification. The trouble arises from the almost hopeless blending and intergrading of all the known types, or the existence of many extremely variable characters. There is, for instance, no one somatic character that will consistently segregate mankind; yet there are some such as hair, color of skin, head form, face form, and bodily proportions that almost rise to that level. Of these the most consistent is the character of the hair, of which three gross types are recognized: straight, wavy, and woolly, each with a distinct cross-section and associated peculiarities. On this basis all living peoples fall into three large groups:

1. Straight hair (leiotrichi). The Asian-American group.
2. Wavy hair (cymotrichi). The Polynesian-European group.
3. Woolly hair (ulotrichi). The Australian-African group.

Though the general reader will find many proposed classifications in anthropological literature, all show a tendency to recognize this three-part grouping. Further, the color of skin, the shape of the head and the profile of the face are found to be in frequent association with type of hair. In consequence we have such tentative groupings as that proposed by Giddings:

"I. *The Australian-African Group.*— Characteristics: black skin, dolichocephalic (long-headed), prognathic, woolly or frizzly-haired (cross-section of hair very elliptical). Area of distribution: Australia and Africa, south of the equator.

"II. *The Polynesian-European Group.*— Characteristics: fair skin, mesocephalic, orthognathic, straight or wavy hair (cross-section slightly elliptical). Area of distribution: broad zone from Polynesia northwestward through southwestern Asia and northern Africa and most of the continent of Europe.

"III. *The Asian-American Group.*— Characteristics: yellow or red skin, brachycephalic (broad-headed), narrow-eyed, lank or straight-haired (cylindrical in cross-section). Area of distribution: eastern Asia and western America, chiefly north of the equator along the semicircular shore-line of Asia and America."

This, however, deals only with living men and does not include extinct forms known by their fossilized fragments. Of these the following have been proposed:

1. *Pithecanthropus Erectus.*—A form found in Java, the zoological position of which is still in doubt.

2. *Homo Heidelbergensis.*— Known from a single lower jaw found at Mauer, near Heidelbeg, Germany, in 1907.

3. *Homo Neanderthalensis.*— This is generally designated as Neanderthal man and is now known by skeletons from ten or more localities in western Europe.

A fragmentary skull found in Piltdown, England, has been classified as a new species, but since the validity of such a position has been seriously questioned, we omit it here. Finally, mention may be made of extinct varieties of the existing species of man, such as the Crô-Magnon, Brün, Alpine, etc., known by skeletons only.

This enumeration presents the bare content of this division of anthropology, the details of which must be sought elsewhere. As to man's precise zoological position we are still in doubt, since the final solution of that problem will be found in fossils of man and related forms.

Linguistic Characters.— The most striking human character is the art of speech. No people have yet been found who were without a highly complex language by which they were able to express very fine shades of meaning. The comparative study of these languages is one of the highly specialized groups of problems that fall to the lot of the anthropologist, particularly the languages of the wilder peoples. Notwithstanding the complexity of speech in general and the somewhat forbidding nature of the whole subject, it has proved easier to classify men according to language than according to somatic structure. As a result, we now have a scheme of linguistic classification that embraces almost the whole of mankind. The fundamental problem here is the same as in zoology, viz., ultimately to discover the genetic relationship between all languages. As a preliminary to this, the languages of the world are now classified into families or stocks, with their subdivisions of languages, dialects, etc. All that show certain evidences of having a common origin are grouped under one family name. As the subject now stands we have something more than 200 such families, with a large number of distinct subdivisions. Further study promises to greatly reduce the number of these families, or at least discover genetic relations between many of them. It is the hope of anthropology that some day we may be able to project the historical evolution of this great human character. This will be a great triumph, for the birth and development of language must be intimately related to man's origin and subsequent career.

Cultural Characters.— The term culture is used to designate the total complex of man's habits and thoughts, or that which he acquires from the group into which he is born. In the zoological sense it is not inherited and so not inborn. Strictly applied, the term culture should include language also, but for purely practical reasons the two are separated. Culture is conceived of as composed of traits or elements, but recognized in complexes. Thus, the production of pottery in a tribal group would be regarded as a trait complex of that

group. The term complex is preferred because the analysis of the phenomenon into ultimate trait elements is not only extremely difficult, but in the last analysis subjective. The subject matter of anthropology, therefore, is in part data on trait complexes, considered as group characters. Anthropologically speaking, a group of people is not adequately described until we have enumerated its chief cultural trait complexes along with its somatic and linguistic characters.

One peculiarity of trait complexes is their frequent independent distribution over whole geographical areas instead of being peculiar to a single tribe. This condition necessitates a geographical classification for culture trait complexes as the initial task. From this as the point of departure, the anthropologist approaches the great problems of culture, viz., its origin, evolution and principles of distribution. Here are to be found some of the most illuminating and stimulating studies of our subject; for example, the discussions of trait-complex diffusion from a single world centre in opposition to the view that such complexes were independently invented by many tribal groups. This applies particularly to the question as to whether the cultures the Spanish conquerors found in aboriginal Mexico and Peru were independently developed or derived directly from the Old World by mere diffusion. For these and many other enticing discussions, the reader must consult the special literature.

However, the mere question of culture distribution is not the whole story, for many cultures have arisen and died out, leaving behind traces in the soil from which they can be partially reconstructed. The methods of investigating these extinct cultures constitute what is known as archæology. In fact the fundamental problem in culture as a whole is to work step by step from the existing cultures to the earliest beginnings. The most complete data of this kind are from western Europe, where we find several great culture epochs with many subdivisions, as indicated in the accompanying tabulation:

1. Paleolithic Age (100,000–12,000?).
   - a. Pre-Chellean.
   - b. Chellean.
   - c. Acheulean.
   - d. Mousterian.
   - e. Aurignacian.
   - f. Solutrean.
   - g. Magdalenian.
   - h. Azylion.
2. Neolithic Age (?–2000 B.C.).
   - a. Campignian Culture (?–7,000 B.C.).
   - b. Swiss Lake Dweller Culture (7,000–3,000 B.C.).
   - c. Late Neolithic and Copper Culture (3,000–2,000 B.C.).
3. Bronze Age (2000–1000 B.C.).
4. Early Iron Age, or Hallstatt Culture (1000–500 B.C.).
5. Later Iron Age, or La Tène Culture (500 B.C.).

These early periods of culture in Europe have been exclusively the discoveries of anthropologists but those investigations that deal with the early fringes to the historic nations such as Greece, Rome, Egypt, Babylonia, etc., fall rather in the domain of the classical archæologist. The only other part of the world where extensive research of this kind has been attempted is North and South America, but the cultures of the New World peoples were unknown before the voyages of Columbus. Hence we have here a closely unified problem because anthropologists can only begin with the cultures found and trace them backward by archæological methods. Somewhat less progress has been made here than in Europe, partly because the area to be covered is ever so much greater and partly because the conditions of investigation present more difficulties. Yet the chronology of the Maya of Yucatan has been established for dates 2,000 years ago; that of the Mexicans falls into three quite distinct periods, etc. Yet as compared with the sequences for Europe these are all recent, for there we can trace man back into the glacial period, while in the New World there is yet no good evidence that man arrived until the close of the ice ages.

All these inquiries into the sequence of early cultures deal with geological and palæontological questions, for if remains of man and his culture are found in association with the bones of extinct animals, we must appeal to the above sciences for aid in determining the age of such a deposit. Thus if we look back over this outline of what anthropology is we note that almost everywhere it brings to bear upon its problems data from other sciences. For this reason it may be considered a synthetizing or co-ordinating science. See ARCHÆOLOGY; ANTHROPOMETRY; CIVILIZATION; ETHONOLOGY; MAN-CHRISTIAN ANTHROPOLOGY; MAN, PREHISTORIC; PREHISTORIC RACES.

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ANTHROPOLOGY IN AMERICA. Since the whole habitable world has long been occupied by man we may expect an anthropology for each grand division of land. Thus, Europe, Asia and Africa being after all one land mass, their peoples have established varying contacts so that the study of any single group can rarely be pursued without some con-

sideration of the whole. On the other hand, Australia and the Americas have no actual land connections with the Old World land mass and consequently the specific anthropological problems of these two areas have little direct bearing upon each other or upon those of Europe, Asia and Africa. Naturally then, when we turn to America, its sharp cultural and racial differentiation from all other parts of the world, together with its great geographical extent and internal anthropological complexity, all combine to make its anthropology a fairly distinct field. Hence, we are justified in treating the anthropology of America as a separate topic.

The history of American anthropology dates back to the first voyage of Columbus, that most famous of all explorers, who found not only a new land, but a new people. The term Indian first given the few known representatives of this people can be consistently applied to all from north to south for an unmistakable somatic unity exists throughout. Since no traces of a totally different people have come to light in either North or South America our subject is strictly the anthropology of the American Indian.

The lead in this study has been taken by the anthropologists of the United States. Among those who have contributed most to the scientific development of American anthropology are Maj. J. W. Powell, D. G. Brinton, Frederic Ward Putnam and Franz Boas. Under the guidance of such men scientific methods were devised and the subject placed on a level with other university studies. However, the greatest impetus came not from the universities of the United States, but from museums and research institutions. Perhaps the most important event in the history of American anthropology was the establishment in 1879 of the Bureau of American Ethnology at Washington, D. C., as a part of the Smithsonian Institution. This institution was from the first effective in research and still serves as an inspiration to all who are engaged in anthropological pursuits. The next great event was the anthropological exhibit at the World's Columbian Exposition at Chicago in 1893, organized by Frederic Ward Putnam. As a result of the great anthropological awakening following this exposition and Putnam's enthusiasm the Field Museum of Natural History was established in Chicago in 1894; the anthropological section of the American Museum of Natural History in New York reorganized; and the University of California museum established in 1901. All of these institutions now maintain a large number of highly trained research men who give their whole attention to anthropological investigations in North and South America.

One of the most signal achievements in American research was the complete linguistic classification of North American tribes under the leadership of Major Powell. This still remains the only true scientific classification of the aboriginal population and it is not far wrong to say that its attainment marks the beginning of American anthropology as a recognized science. Practically all of the native languages spoken in the United States and Canada have been recorded and in many cases texts in the original have been printed. At present the chief interest of anthropologists is in seeking out relationships between what have so far been considered independent languages. Already some progress has been made in this direction and we may expect in the near future a satisfactory reconstruction of the linguistic history of the tribes inhabiting North America. For South America there has been less progress, but a provisional classification has been made that embraces all the known tribes.

Perhaps the next most distinctive work is that of Lewis H. Morgan and his follower, Adolph Bandelier. Morgan's work stands out as one of the world's great contributions to anthropology and sociology. His theories of marriage and the origin of society broke new ground, but they were all based upon concrete studies among living Indian tribes. Bandelier, inspired by Morgan's genius, made a critical examination of Spanish historical sources of data upon the organization of native society in Mexico City, for the first time making it evident that American native culture from the highest to the lowest had a common basis and in all probability a single origin. However, Bandelier's greatest work was among the ruin-strewn mesas and deserts of southwestern United States, where he skillfully combined documentary data and native tradition with the objective study of the ruins themselves. Though essentially pioneer work, these studies of Bandelier will ever remain the great synthetic classics in American anthropology.

The next great concern of American anthropologists has been the relative antiquity of man's first appearance in America and the establishment of a chronology for his subsequent career. The most important advance in this direction was the deciphering of prehistoric inscriptions found upon the famous ruined cities of the Maya in Yucatan and their co-ordination with our own calendar, according to which we are able to establish dates as early as 200 B.C. Yet in the development of chronologies based upon archæological stratification, little progress has been made in sharp contrast to what has been achieved in western Europe. However, there is now a newly-awakened interest in chronological research and new developments may be expected at any moment. See ARCHÆOLOGY; INDIANS; MOUND BUILDERS.

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ANTHROPOMETRY (Greek *ἄνθρωπος*, man, and *μέτρον*, measure), a term denoting both the system of identification based upon measurements of certain portions of the human frame and also — especially at the present time — the science having for its object the systematic examination and study by means of classification, of the height, weight, strength and other physical characteristics of individuals representing the different races of mankind. With the former (the system of identification, and particularly the identification of criminals) the name of the distinguished French investigator, Alphonse Bertillon (see BERTILLON and BERTILLON SYSTEM) is indissolubly united. The tendency has become strongly marked in recent years to adopt the system of identification by finger prints in lieu of such measurements of the head, of the forearm, etc., as are more difficult to secure with the requisite degree of accuracy, in outlying districts and in fact wherever erroneous measurements might be recorded as a result of insufficient skill in the use of the Bertillon instruments (see FINGER PRINTS). Investigations purely scientific in character and covering a wide range of subjects are now classed as anthropometrical. For example, the studies of such modifications as changes of environment produce in the bodily form of human beings, or again the statistics of physical development during courses of training under competent instructors, may be appropriately classified in this manner. As for the comparative studies in this field, and the conclusions reached in the new science that may be called quite properly comparative anthropometry, their interest is merely suggested by the following list, which shows the average height of the adult males of the principal races or nationalities of the world: Polynesians, 69.33 inches; Patagonians, 69 inches; Negroes of the Kongo, 69 inches; Scotch 68.71 inches; Iroquois Indians, 68.28 inches; Irish, 67.90 inches; United States (whites), 67.67 inches; English, 67.68 inches; Norwegians, 67.66 inches; Zulus, 67.19 inches; Welsh, 66.66 inches; Danes, 66.65 inches; Dutch, 66.62 inches; American negroes, 66.62 inches; Hungarians, 66.58 inches; Germans, 66.54 inches; Swiss, 66.43 inches; Belgians, 66.38 inches; French, 66.23 inches; Berbers, 66.10 inches; Arabs, 66.08 inches; Russians, 66.04 inches; Italians, 66 inches; Spaniards, 65.66 inches; Eskimos, 65.10 inches; Papuans, 64.78 inches; Hindus, 64.76 inches; Chinese, 64.17 inches; Poles, 63.87 inches; Finns, 63.60 inches; Japanese, 63.11 inches; Peruvians, 63 inches; Malays, 62.34 inches; Lapps, 59.2 inches; Bosjesmans, 52.78 inches. The average stature of man is thus about 65.25 inches.

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ANTHROPOMORPHISM, a term expressing the representation or conception of Deity under a human form, or with human attributes and affections. Such a conception springs from the natural inaptitude of the human mind for conceiving spiritual things except through sensuous images, and in its consequent tendency to accept such expressions as those of Scripture when it speaks of the eye, the ear, and the hand of God, of His seeing and hearing, of His remembering and forgetting, of His making man in His own image, etc., in a too literal sense. The term is also applied to that doctrine which attributes to animals mental faculties of the same nature as those of man, though much lower in degree: strictly called biological anthropomorphism, to distinguish it from anthropomorphism proper, or theological anthropomorphism.

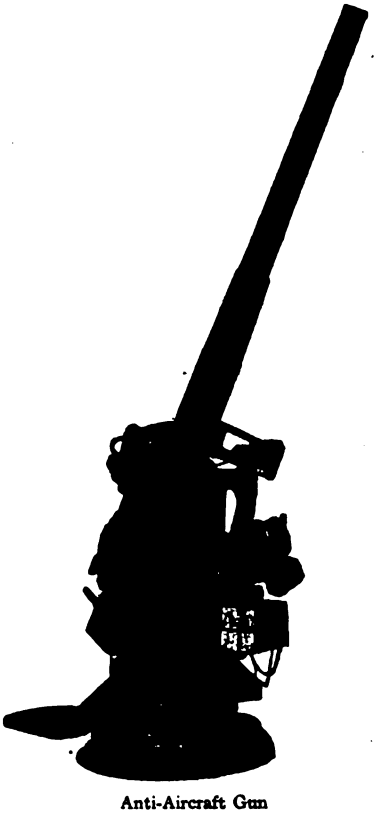
ANTHROPOPHAGI, the name given to individuals or tribes by whom human flesh is eaten: man-eaters, cannibals. The Caribs are said to have been cannibals at the time of the Spanish conquest of America, and the word "cannibal" is derived from their name.

ANTI, or CAMPA, a warlike tribe of southern Peru on the eastern slope of the Andes. Their principal garment is a poncho belted at the waist. The men are workers in metal to a considerable extent, and the women are skillful weavers. They cultivate the ground, wild animals, tamed, serving as beasts of burden.

ANTI-AIRCRAFT GUNS. As a solution of the problem presented by the conditions of firing at great heights and at large angles in order to reach airplanes or balloons, the Krupp firm has brought out three general types of cannon, each of which is adapted for a special use. In the first place, there is the more simple type of cannon with field mounting, while a second type is constructed with a view of being placed upon a motor car. For use on shipboard a third type is designed intended to be rapidly rotated in all directions by the use of a central pivot base such as is usually installed on warships for coast-defense use. On the other hand, the field gun has its wheels arranged so as to turn upon pivots, which allows of placing the wheels in crosswise direction. In order to give effective results it is found that the angle of elevation must be at least 70 degrees, and the field gun is designed to reach this angle. The automobile and ship cannon will, however, make a greater angle, the maximum being for these two types as high as 75 degrees. In all these cases

a rapid rate of firing is given by an automatic opening and closing of the breech. The calibre has been reduced as much as possible, as also the weight of the projectile, while the long bore gives a high initial speed to the shot and diminishes the time required to attain the mark. Owing to the lessening of the calibre, greater lightness is obtained, and this is of service especially in the field and the automobile types of gun.

Sighting is carried out in the most efficient manner by the use of an appropriate form of sighting telescope in combination with a general finder which covers a wider range of field. There is also a range-finder by which the distance is first obtained, and afterward the indications are directly given so as to be able to point the gun for different heights of the air-



Anti-Aircraft Gun

ship without loss of time, and thus the use of firing tables is dispensed with in all these cases.

The question of the kind of shot which is best adapted for firing upon balloons or airships is of prime importance; and this matter has been made the object of a number of experiments. It is recognized that shrapnel will penetrate the balloon envelope, but without doing much damage, at least of an immediate nature, seeing that the holes are closed again for the most part by the internal pressure of the gas, so that the loss of gas is not a rapid one and the airship is able to reach a place of safety in the majority of cases. It is found that the most effective form of projectile is a special kind of grenade, which is designed to explode in the interior of the balloon and to bring about ignition of the gas. The projectile designed by the Krupp firm is intended to accomplish this, and at the same time the path of the projectile from the time it leaves the gun can be followed by the use of a special smoke produced carried on the shot. By observing the trail of smoke the gunner learns whether the shot comes near the mark. When the projectile leaves the gun, the smoke producer has been set working by an appropriate device. At night the path of the shot is still followed by the light which the smoke producer gives out. When it penetrates the envelope, a very sensitive device causes the detonation of the grenade.

In the case of the field cannon, which has a 6.5 centimetre bore (2.6 inches), the weight of the gun itself is 775 pounds and that of the chassis 1,150 pounds, making a total of 1,925 pounds for the cannon when prepared for actual service. The gun can be turned about through a complete circle, and has a maximum vertical angle of 70 degrees. The weight of the projectile for this type is nine pounds. The initial speed of the shot is 2,050 feet per second. With the field gun it is possible to cover a maximum range of 28,550 feet, and a maximum height of 18,800 feet.

Of a heavier build than the former, and also of greater range, is the second type of gun of 7.5 centimetre (three-inch) calibre, which is designed to be mounted upon a heavy motor car. Like the former, it is provided with hydraulic recoil brake, and in the present case there is used a middle pivot. For elevating and lowering the gun through the required range there is used a double-toothed sector which is driven by pinion and crank. A special arrangement is used for the rotation, by which a slow movement is obtained, but a quick rotation may also be given by the more rapid mechanism when it is needed to turn the gun rapidly into any desired position. It is to be noted that, owing to the high speed at which airships move, such quick movements are one of the features which need to be especially designed in the case of guns for balloon firing. The weight of the gun itself, 990 pounds, combined with the weight of the support, 1,550 pounds, gives a total weight of 2,540 pounds for this type of gun. We have here the maximum angle which is reached in the Krupp cannon, or 75 degrees. The weight of the projectile is 12 pounds, and the initial speed 2,060 feet per second. The maximum range is about 30,000 feet, and the greatest height about 20,000 feet. As regards the automobile car which is designed to take the present cannon, its total weight (exclusive of the gun) is three and a half tons, and it has an average speed of 30 miles an hour.

Owing to the fact that both axles are driving axles, with the use of the 50-horsepower motor the automobile car is able to travel over very difficult ground, and it easily mounts very steep grades. Under the front seat is a roomy chest which holds a good supply of tools and extra fittings, and special attention has been given to this point so that the car will not easily become disabled.

The Ehrhardt gun factory of Düsseldorf has also built various anti-aircraft guns, mounted on motor trucks, whose calibres vary from 50 to 105 millimetres. The most remarkable of these is the 35-calibre 65-millimetre design which fires a 4.1 kg. projectile to a maxi-

mum height of 5,800 metres with an arc of elevation of 75 degrees and a muzzle velocity of 670 metres per second. This gun can fire three varieties of projectiles: (1) Ordinary shrapnel containing 150 steel balls of 9 grams each; (2) a smoke shrapnel of 170 steel balls of the same weight; and (3) a "balloon grenade," which is especially adapted for use against airships. This gun is mounted on an armored motor car and weighs complete 6,650 kg. The Skoda Gun Works of Pilzen, Austria, also supply an anti-aircraft gun which has a bore of one and a half inches and is 70 calibres long. This gun has a muzzle velocity of 1,000 metres per second and fires a projectile weighing 0.8 kg. at an elevation up to 80 degrees. It weighs complete 615 kg. and can be mounted on any suitable high-power motor car.

ANTI-CATHOLIC RIOTS. See ORANGEMEN.

ANTIARIN, the poisonous principle found in the milky juice of the upas tree (*Antiaris toxicaria*) in Java. It has the probable formula $C_{14}H_{20}O_5+2H_2O$. The gum prepared from the upas juice is used by the natives of Java for poisoning arrows. Antiarin, when taken into the stomach or introduced into the circulation through a wound, causes great prostration and, in sufficient quantity, paralysis of the heart.

ANTIBES, äṅ-tęb, a fortified town and seaport of France, on the Mediterranean, 11 miles south-southwest of Nice; founded about 340 B.C. by a colony of Greeks, who named it Antipolis. It has a naval school and exports olives, anchovies, perfumery, etc. Pop. town, about 6,000; commune, 11,000.

ANTIBODY. See IMMUNITY.

ANTICHLOR, ăn'tĭ-klōr (from *chlorine* and *anti*). In bleaching, any substance used to eliminate, by chemical means, the last traces of chlorine from a material that has been bleached by the action of a chlorine compound. The free chlorine can be largely removed by mere washing, but it cannot be entirely eliminated in this manner, and the residuum, if not removed by chemical means, is injurious to the material and causes it to disintegrate slowly. Sulphur dioxide was long used as an antichlor, its action being indicated by the following formula: $SO_2+2H_2O+2Cl=H_2SO_4+2HCl$; that is, it combines with the chlorine to form sulphuric and hydrochloric acids. Sulphite of soda, Na_2SO_3, is equally effective, its action being as follows: $Na_2SO_3+H_2O+2Cl=Na_2SO_4+2HCl$. Sodium thiosulphate (better known in the arts as hyposulphite of soda, or "hypo,") is now more commonly used as an antichlor, since it is both cheaper and more efficacious. Its formula is $Na_2S_2O_3$, and its action is as follows: $Na_2S_2O_3+5H_2O+8Cl=Na_2SO_4+8HCl+_2SO_4$. (Sodium thiosulphate, water, and chlorine yield sodium sulphate, hydrochloric acid, and sulphuric acid). In practice carbonate of soda is often added to the antichlor to neutralize the acids formed by the absorption of the chlorine. The resulting salts of soda are easily washed out of the material treated; and no damage results even if they are not entirely removed.

ANTICHRIST, a term of Biblical origin, but occurring only in the Epistles of John, where it signifies a person or persons who deny the Father and the Son and disown the incarnation and messiahship of Jesus. They are deceivers whose presence in the world betokens the last time. This writer seems to have in mind numerous false human teachers, originally members of, but always alien to the followers of Christ. He seems also to refer to some single arch-deceiver of whom all false teachers are exponents, and in whom is concentrated all antagonism of error and ill will to Christ and His kingdom of truth and grace. There are, however, other Biblical passages in which such antagonisms find acute and culminating expression, and it has been the custom of students to handle all these sections under the study of the Antichrist. Such passages are Matt. xxiv, with its allusions to false prophets and false Christs; *2* Thess. ii, with its "man of sin"; Rev. xi, xii, and xiii, with its dragon and beast; and Daniel vii and viii, with its figures of the terrible beast and the he-goat. In all these passages a central feature is the mighty opponent and assailant of the people and purposes of God. Clustered about this central personified or personal antagonist of all worshipers of the true God numerous significant features continually recur. Such are names, times, places, forms. These features, variant in themselves when differently combined by would-be interpreters, yield perplexingly manifold and divergent schemes, as the history of the theme abundantly displays.

The history of interpretation shows four names to have special eminence alongside the name Antichrist, thus: Dragon, Satan, Demon, Belial. The efforts to identify him cluster around typical views. Some deem him to be a form of Jewish antagonism to the Christian faith. Here he is traced to Capernaum, Chorazin, Bethsaida or to Jerusalem. Frequently he is described as hostile to the Jews, being the counterfeit and foe of the Jewish Messiah. Very many identify him in some way with Rome, naming pre-eminently Nero, or a *Nero redivivus,* or Titus, or Caligula. Quite commonly in the Middle Ages he was seen in Mohammed or in the Turks. Still later some Catholics identified him with Luther, while the Reformers identified him with the Pope. Many emphasized in the Antichrist, whatever his form, the energy or wisdom or very being of Satan or the Dragon. Many writers refer all the Biblical allusions to events current at the time of writing. Many others deem the reference to events still future. Still others hold the Biblical teachings to be preeminently predictive, but find their fulfilment partial and manifold throughout all Christian history, until their final consummation will mark the end. As to the place of his appearance or activity mention may be found of the Jewish Temple, Jerusalem, Mount of Olives, heaven itself. Closely connected with these central features are various attendant elements such as Michael, his great antagonist and victor; Gog and Magog and the nations which are his minions; the miracles which he works; the two witnesses, Enoch and Elijah, whom he slays; the sign of the Antichrist and the Son of Man; his world dominion; and his final doom. It is manifest that this theme presents a program of thought and activity of most profound significance, however perplexing its

solution. The persistence of its main elements through such a long train of history attests something vital in human life. But its outline is nowhere complete. In recent years the effort to solve its mystery and find its meaning has taken new form and course. Scholars are trying to trace every element of the Antichrist tradition to its historical source. The leaders here are Dieterich, who, in his 'Abraxas' and 'Nekyia,' traces parallelisms in Greek myths; Gunkel, who, in his 'Schöpfung und Chaos,' attempts the same task in old Babylonian mythology; Bousset, who, in his 'Der Antichrist,' explores post-Christian literature of all types for echoes of the tradition; and Friedländer, who, in his 'Der Antichrist in den Vorchristlichen Jüdischen Zuellen,' tries to show that every essential trait of the Antichrist is traceable in Jewish circles before the destruction of the temple. The writer last named conceives the Babylonian dragon myth, the Hebrew sons of Belial, the foes of God and his Messiah in Ps. ii, the Zedim of Ps. cxix, the minim of various Jewish writings, the Belial of the Sybilline oracle, the Gnostics, the great antagonist of Daniel, the man of sin in 2 Thess. ii, the false Christ of Matt. xxiv, the Antichrist of John's Epistles, and the dragon of Rev. xi, to be all and severally various phases in one consistent development of the Antichrist idea. These studies, though but the early stages of a mighty task, disclose a commanding theme. For a history of the exposition of 2 Thess. ii consult Bornemann's 'Commentary' in the Meyer series. For a thorough statement of the Nero speculations consult De Wette's 'Excursus' in his 'Commentary on Revelation xvii'; also Charles, R. H., 'The Ascension of Isaiah' (§ 17).

ANTICLINE. See FOLDS.

ANTICLINORIUM. See FOLDS.

ANTICOSTI, a barren island in the Gulf of Saint Lawrence, 135 miles long and 40 miles at its greatest width. The hills in the interior rise to about 600 feet. The climate is severe; while the surface is an alternation of rocks and swamps. It is visited by fishermen in the summer, but there are few inhabitants save lighthouse keepers and official residents. The island, which is attached to the Canadian province of Quebec, has considerable salmon, trout, cod and herring fisheries and is a resort for seal- and bear-hunting. In 1895 the island was purchased by M. Henri Menier of France, who had much litigation over the rights of some settlers. A decision in his favor was made in 1900. Pop. 250.

ANTICYCLONE, an atmospheric condition characterized by high barometric pressure and outblowing winds—the opposite of cyclone. An anticyclone extends over a wide area and in the temperate zones usually appears in the west and moves eastward with slow velocity. At the centre of the area the winds move downward, thus bringing the cool, dry air of the upper regions into contact with the earth's surface. Anticyclones are generally accompanied by clear, pleasant weather, but when following a storm in winter they may result in cold waves. See METEOROLOGY.

ANTICYRA, ăn-tĭs'ĭ-rą, the name of three Grecian towns in Thessaly, Phocis and Locris, famous for the hellebore which grew in their neighborhood. This plant was in high repute as a medicine and was thought to have the effect of clearing the brain and curing stupidity; hence the expression of Horace, "*Naviget Anticyram,*" "Let him sail to Anticyra."

ANTIDOTES. See POISONS.

ANTIEMETIC. A remedy employed to relieve nausea and vomiting. The choice of an antiemetic depends very largely on the nature of the cause of the nausea and vomiting. There are local antiemetics, acting solely on the mucous membrane of the pharynx, œsophagus or stmoach, and central antiemetics, acting on the nervous system. Among the best local remedies are cracked ice, cold beer, cold carbonated waters, cold champagne, small doses of tincture of iodine, chloroform, belladonna, cocaine, bromides or chloral. The most reliable general antiemetics are ipecac, opium and its alkaloids. See EMETIC.

ANTIEROSION COATING. This coating for projectiles is used to prevent erosion by eliminating contact between the surface of the projectile and the surface of the bore during travel in the bore. It is not a lubricating but a plastic substance, such as silicate of soda, alone or mixed with powdered clay. Adhesion of the substance is increased by roughening the surface of the projectile, chemically or mechanically. Without such precaution the coating might be stripped off by the rifling.

ANTIETAM, ăn-tē'tăm, The Battle of, fought on 17 Sept. 1862, in Maryland; sometimes called the battle of Sharpsburg. It was one of the decisive engagements of the Civil War, as it ended the first Confederate attempt at invasion of the North, though tactically a drawn battle. Lee's army of about 50,000 crossed the Potomac near Leesburg, some 30 miles above Washington, and concentrated around Frederick, about 40 miles from Washington and 20 miles from the Pennsylvania line. When it became known that Lee had crossed into Maryland General McClellan, in command of the Army of the Potomac, pushed forward several corps with the left on the Potomac.

Meanwhile Lee had ordered a movement on Harper's Ferry (q.v.), in his rear at the junction of the Potomac and Shenandoah. It was a valuable defense against invasion through the Valley of Virginia, but once the Confederates were across it became not only worthless but a trap. Nevertheless General Halleck ordered it held; and Lee grasped the chance of capturing its defenders (with the Martinsburg outpost) and opening up his communications at once. This involved dividing his army for days, with a much superior force two or three days' march off, but he gauged his foes justly enough to take the risk. The operation was effected with great skill and success and accurate co-ordination; but it took longer than Lee expected, and a mischance befell which should have undone him. A copy of his order fell into McClellan's hands on the 13th, telling him of the dividing of that army not far off, its object, the position of the separate detachments, and the premium on expedition; but the opportunity was lost to the Federals through Mc-

Clellan's unexplained delay in giving orders for an advance.

Lee, advised by the night of the 13th at Hagerstown that McClellan was advancing on South Mountain, marched back to resist his advance but was defeated and on the night of the 14th fell back to Sharpsburg, a few miles southwest of Boonsboro, as the nearest strong position for his Harper's Ferry detachments to rejoin him, as on the flank and rear of any force menacing Maryland Heights which they occupied, and a very defensible position in itself. Six or seven miles above the Heights the Potomac receives Antietam Creek, flowing through a ravine, with banks rising on the west to a low ridge having wooded patches, ledges, stone and wooden fences, cornfields, etc., as natural bulwarks, and sloping on the western side to the Potomac. Two and a half miles above the confluence a sharp eastern bend of the Potomac brings it within two and one-half miles of the Antietam; and at about the centre of the peninsula thus formed lies Sharpsburg, in a hollow on the western slope. Lee's line, about three miles along the crest, was to rest one flank on an elevation near the Potomac, with the village in the rear centre, and a secure retreat by the Shepherdstown ford of the Potomac in the rear.

The Union troops having forced South Mountain (q.v.) by two sharp battles on the 14th, the main body issued therefrom next morning, marched the eight miles to Antietam Creek and formed in line along the east ridge. By afternoon some 50,000 troops were opposed to about 30,000 under Lee, with Longstreet and D. H. Hill. Late in the afternoon McClellan came up, was received with immense enthusiasm and decided that it was too late to attack that day. On the 16th Jackson and Walker had joined Lee with fully 10,000 more. The chance of splitting the Confederate army being now lost, McClellan waited for his ammunition and supply trains to arrive and ordered no attack save of Hooker's corps on the right late in the afternoon. A list of divisions and commanders now becomes requisite for brevity and intelligibility in describing the battle.

UNION ARMY.

Right Wing.—Joseph Hooker. First Corps: Joseph Hooker; three divisions; commanders, Abner Doubleday, J. B. Ricketts, G. G. Meade.

Centre.— E. V. Sumner. Second Corps: E. V. Sumner; three divisions; commanders, I. B. Richardson, John Sedgwick, W. H. French. Twelfth Corps: J. K. F. Mansfield; two divisions; commanders, A. S. Williams, G. S. Greene.

Left Wing.— A. E. Burnside. Ninth Corps: J. D. Cox; four divisions; commanders, O. B. Willcox, S. D. Sturgis, I. P. Rodman, J. D. Cox (in the battle, E. P. Scammon). But Burnside refused to take personal command of the corps because, while he had previously commanded the right wing with the First and Ninth under him on the day previous, the former (Hooker's) had been taken from him and made an independent command; he feared that acquiescence would lose it to him permanently, and merely transmitted orders through Cox. The corps therefore had a technical commander who would not exercise initiative and a real one who could not.

Reserve.— Fifth Corps: Fitz-John Porter; two divisions; commanders, George Morell, George Sykes. Sixth Corps: William B. Franklin; two divisions; commanders, H. W. Slocum, W. F. Smith. Temporarily attached, D. N. Couch's division from the Fourth Corps. This came from Pleasant Valley during the forenoon and portions were used as reserves. Couch's division did not reach the field until after dark of the 17th.

Cavalry.— Alfred Pleasonton.

CONFEDERATE ARMY.

First Corps.— James Longstreet. Five divisions; commanders, Lafayette McLaws, R. H. Anderson, D. R. Jones, J. G. Walker, J. B. Hood.

Second Corps.— T. J. ("Stonewall") Jackson; four divisions; commanders, I. R. Jones, A. R. Lawton, A. P. Hill, D. H. Hill.

Some crucial points of the battle-ground must be noted. The heart of the fighting was north and east of a Dunkard chapel of red brick, a mile north of Sharpsburg on the west side of the Hagerstown turnpike, with tall woods free from underbrush to the west and north (the "west woods"), and elevated ground with ledges, hollows, etc., to the north (Nicodemus' Hill) and west. Next to and across the road was open ground, with a field of high strong corn opposite the north end of the west woods, and then the "east woods," also interspersed with rocks, with a commanding ridge running south, cut by a sunken road (the "Bloody Lane") running east from the turnpike.

On the morning of the 17th Fitzhugh Lee's cavalry brigade and some artillery formed the extreme Confederate left, holding Nicodemus' Hill; next Jackson, Jones' division, in and in front of the west woods, and the bulk of Ewell's division on Jones' right, in the open ground east of the Hagerstown turnpike; D. H. Hill on the left centre. Longstreet formed the centre and right, and A. P. Hill on the extreme right came up in the afternoon. Hood on the left was relieved by Ewell the night before, and formed a reserve near the Dunkard church. McLaws withdrew from Maryland Heights on the 15th and 16th, crossed and recrossed the Potomac and rejoined Lee early on the morning of the 17th, also taking post on the left.

On the Union side, Hooker having crossed the Antietam, Mansfield also crossed in the night and took position in the rear. Sumner and Burnside remained east of the stream. The Confederates rightly inferred from the Union dispositions that the force of the attack was to be on their left, and strengthened it accordingly; 10 of the best brigades in their army were placed in the west and east woods and south of the cornfield. They had nearly 40,000 men in the battle; the Union troops engaged numbered about 55,000. This superiority was little enough against the immense advantages of the Confederate position; and even so, it was frittered away in a series of disconnected attacks, which left a large part of the Confederate force usable at one time against 15,000 Federal troops at most.

1. Hooker, lying nearly a mile north of the Dunkard church, moved down against Jackson early in the morning; reported strength 14,856; actual, under 10,000. The objective point was

the elevated ground about the church. The march had its right on the turnpike and its left along the west edge of the east woods, from which a withering fire checked it a little; the right was raked by a flanking fire from the west woods. At length the line gained the southern edge of the cornfield and engaged the Confederates in the open ground about 220 yards distant. Under the storm of bullets, shot and shell that rained upon them, they broke and fled through the corn, to reform in a hollow beyond; the Confederates assailed the Union lines in turn, and in turn were riddled by a concentrated fire that drove them back. Again the Union troops advanced, to be forced back in disorder; and again the Confederates followed, to break and fly. This was one of the most frightful carnages of the Civil War: Jackson's famous "Stonewall" division was nearly annihilated, more than half of two brigades killed or wounded and more than a third of another, and all the regimental commanders but two. On the Union side 1,051 in Ricketts' division were cut down, a third of its whole number, and two brigades lost over 40 per cent: Hooker was wounded and was succeeded by Meade. Hood and D. H. Hill now came up to replace Jackson's losses; and Hooker's remnants slowly withdrew northward just as the advance of the Twelfth came up, though Ricketts still held the edge of the east wood.

2. Mansfield was mortally wounded while deploying his troops about 7 A.M., and A. S. Williams took command: reported strength, 10,126; actual, about 7,000. Marching more obliquely to the road, facing southwest, they cleared the cornfield, and about 8.40 A.M. drove the Confederates across the turnpike and into the west woods.

3. The Second corps, under Sumner, had not received orders to march till 7.20, after the First was crippled and the Twelfth in the thick of action; and Richardson's waiting for Morell's division of the Fifth corps to occupy the ground he vacated caused him to be an hour later still. Sedgwick's division, with Sumner at the head, went first, French following; each with perhaps 5,000 men; they crossed the Antietam, moving west by north, till the centre was nearly opposite the Dunkard church; then deploying, faced west, French forming on Greene's left. Sedgwick passed through the east woods and the cornfield; advanced swiftly in three lines, no regiments in column or ready to face to either flank if attacked, swept by Greene's right and pressed through the west woods with left on the church, to the western edge and a wood road along it. Meantime McLaws and Walker with six brigades had come up, one brigade had been drawn from the right to reinforce Early's forces of Ewell's division; and all fell upon Sedgwick's left flank and rear. Nearly 2,000 Union soldiers were struck down at a blow without a chance to retaliate; this division lost 2,255 men in all, more than 40 per cent of its entire number, including Sedgwick severely wounded. Sumner tried to change front, but the lines broke and scattered northward, sweeping away everything in their rush, and only reformed on the north hill where Meade and the First corps had taken refuge. A brigade of the Twelfth came up to help, but lost a third of its number, one regiment losing 60 per cent. The right of the Confederate attacking line crossed the turnpike at the Dunkard church and made two assaults upon Greene's position east of the church, and were repulsed with great slaughter, and Greene, making a counter charge, entered the woods beyond the church. Greene held this position until noon, when the Confederates attacked both his flanks and drove him from the church.

Meantime W. F. Smith of Franklin's corps had come on the field. Hancock (then one of his brigadiers) obtained a regiment from Sumner, took position opposite the woods, drove away the approaching Confederate skirmishers, and silenced their batteries. A second brigade was placed on his left, and with heavy loss advanced to near the church; but on sending for his reserve brigade to support it he found it had been ordered away to support French. The latter moving to the left south of the east woods, over the farm lands, drove back D. H. Hill's skirmishers to his main line in the sunken road, where he engaged him over an hour, when he was joined by Richardson. Here a long and sanguinary conflict ensued: the Confederates turned the "Bloody Lane" into a rough fortress with fence rails, and before carrying it the Union divisions had lost near a third of their total, one regiment losing 60 per cent. They had won the position by perhaps 1 P.M., and shortly afterward French's troops were relieved by a brigade of Smith's division. Richardson withdrew his men to the ridge, and about that time was mortally wounded and succeeded by Hancock. This practically ended the operations on the Federal right, and indeed the battle of Antietam so far as it had any tendency to change the status quo. When Richardson's line had been withdrawn, there was a vigorous contest of artillery. Meagher's brigade took the centre, and somewhat less than two regiments came from French to aid Richardson's division. Despite the application for artillery for the division, none had been obtained. The length of the Union line made it impossible that more than one line of troops be formed; and so far advanced was this line that a part of it was continually swept by the fire of the batteries on the Confederate left, these batteries being protected by the west woods. An attack on the Union left was successfully repulsed by Hexamer's battery (obtained from Franklin) and Battery I, First artillery.

4. Between 4 and 5 P.M. a regiment of Franklin's corps was ordered to drive away some skirmishers of Hill's division south of the Bloody Lane and succeeded at the cost of half its force.

5. The battle which Franklin was not allowed to fight must be mentioned. It has been noted that Smith's action was paralyzed by taking away a third of his force for service elsewhere. About noon Slocum, with the other division, reached the field, and two brigades were at once formed in line to carry the woods around the church; but again the reserve brigade was ordered off. Franklin urged with all his strength to have a grand assault made with his whole corps on Lee's centre, crippled and worn out with half a day's fighting and slaughter. With relatively fresh troops and French and Richardson to aid, it is most probable that few Confederates would have crossed into Shepherdstown. But Sumner refused to permit the movement; still, Franklin was so

urgent that he referred the decision to McClellan, but with so strong a veto that McClellan deferred to him and sanctioned the refusal. Both credited Lee with double or treble his actual numbers, and considered the terrible resistance, not as a proof that it could not be continued, but that any force which assailed him went to destruction. This refusal forms another of the might-have-beens of the battle, with some peculiarly poignant personal tragedy involved.

6. The action of the left under Burnside is an even more acute personal question. His peculiar position has already been noted. About 7 A.M. he received an order to hold himself in readiness to carry by assault a stone ridge across the Antietam about a mile southeast of Sharpsburg. About 10, when the First and Twelfth corps and Sedgwick's division were out of the fight, he received another order to carry the bridge and the heights beyond and advance on the rear of Sharpsburg. He turned it over to Cox, who ordered a brigade to storm the bridge, Rodman to cross by a ford one-third of a mile below, and the two to carry the heights and unite there. At best this could not be done in a moment, and the movement seems a covering rather than an aggressive one. But Crook missed the bridge and could not get back to it under fire: Rodman missed the ford and was two hours or so crossing under fire; a fresh storming party finally carried the bridge, Crook crossed some companies above and others at the bridge, and Rodman and the rest united about 1 P.M., when the battle on the right was virtually over. Meantime Sturgis' division had run out of ammunition and was reported unfit for duty; it was replaced by Willcox's (Burnside assisted in this), and at 3 P.M. the corps was again ready to move, though much damaged by the constant Confederate artillery fire. The right wing broke Jones' division and gained the suburbs of Sharpsburg; but the left was strongly checked, and the two wings grew widely separated. Meantime A. P. Hill came upon the field, having marched 17 miles in seven hours. He took Rodman's division in its undefended flank (the second misadventure of the sort that day), and Rodman was killed, while a concentric fire mowed down his men. The losses of the corps were 2,349; a fearful total, almost exactly those of Sedgwick's division. A panic was averted by Scammon, who changed front and checked Hill for a little; Cox called up Sturgis and made head for a while: but at length the corps was obliged to withdraw to the cover of the hills that border the Antietam.

The Union losses were 12,410: 2,108 killed, 9,549 wounded, and 753 missing. More men were killed on this one day than on any other of the Civil War. The Confederate losses were never known with exactness; but as 2,700 of their dead were counted and buried by the Union forces, and many had previously been buried by their comrades, the total cannot have been less than the Federal. The next day Lee retreated across the Potomac unopposed: the failure to pursue him was one of the grievances against McClellan later, but most of his generals concurred with him. Although Lee had escaped destruction, he had none the less failed in his campaign.

Bibliography.— The Count of Paris' 'History of the Civil War' (Vol. II, 1876), is from the standpoint of a strong admirer of McClellan, whose staff he was on; F. W. Palfrey's 'The Antietam and Fredericksburg' (1882), from a lieutenant-colonel of Sedgwick's division, is sharply critical of nearly all the Union generals; John C. Ropes' 'Story of the Civil War' (Vol. I, 1894), is from a noted military critic; Michie's 'General McClellan' (1901), is from a distinguished engineer officer and professor at West Point; the account in 'Battles and Leaders of the Civil War' (New York 1884–88), is by Gen. J. D. Cox. Consult also 'McClellan's Own Story' (1866), and Hays, H. A., 'Antietam and Its Bridges' (1910).

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ANTIFEBRIN, a trade name for the substance known to chemists as acetanilide (q.v.).

ANTI-FEDERALISTS, the first political party in the United States after the separation from Great Britain. The loyalists having been expelled, there was no issue to divide upon till the question of replacing the loose Confederation with a stronger bond came up. The representatives of commerce and capital, and the mass of the educated classes, favored ratifying the Constitution; those who feared that a strong government meant a disguised new kingship, the local leaders who wished to retain pre-eminence, and the conservatives who thought no evils comparable to those of change, opposed it. The names were in direct opposition to the facts, the Federalists striving to turn the federation into a unified nation, the Anti-Federalists endeavoring to preserve a loose disintegrated federation. The victory of the superior classes was overwhelming, one great cause being that the men who were later the leaders of the Anti-Federal opposition were Federalists (q.v.) for the time being, as they felt that the existing condition of affairs was intolerable. In the organization of the first Congress and executive under the Constitution, the Federalists proper held every post but three, and even those were not technically «anti» till later. In this Congress, though there was much individual opposition to the Federalist measures, it was unorganized, and the Anti-Federal spirit could hardly be said to animate a body. Hamilton's scheme for clearing up the public debt was the first point of division. The payment of foreign debts was carried unanimously; that for paying the Continental debt at par was opposed by Madison and others except as to original holders; that for assuming the State debts was bitterly fought as defaming the States' solvency and as buying the support of capital for the Federal government, was carried by only five votes, reconsidered and beaten by the seven votes of the new North Carolina just admitted, again reconsidered and carried by Jefferson's log-roll of establishing the new capital on the Potomac. His national-bank scheme (1791, opposed by Madison in the House and Jefferson and Randolph in the Cabinet) and his tariff and excise schemes also excited a growing hostility from this element, which by the time of the 2d Congress (1 Oct. 1791) was becoming a new strict-construction party; no longer opposed to the Constitution as such, but opposed to extending its powers

beyond the most literal interpretation of its terms. Jefferson, Madison, and Randolph were now the chiefs of the new party in public office; but Jefferson disclaimed being an Anti-Federalist, based his policy on love of "republicanism," as sympathizing with the French Revolution, and called the Hamiltonians "monarchists." The Republicans and Anti-Federalists comprised the same elements, however, and were based on the same natural division, and Washington's proclamation of neutrality in the European conflict in 1793 fused them into one as the Republicans, later into the Democratic-Republican party.

ANTIFRICTION METALS, a group of alloys used in the manufacture of machine bearings to minimize friction. The theoretically ideal bearing would be composed of the hardest metal available. Practically, in spite of the highest skill in forming both the journal and its bearing, there are minute inequalities which have the effect of reducing the area of actual contact to a few isolated patches, resulting in the heating and eventual destruction of the shaft. To obviate this difficulty the bearing metals have been developed by so alloying their components that a very large series of plastic metals has been produced with the two essential properties of being soft enough to adapt their form to the journal for which they are intended, and hard enough to hold their form against the pressure upon them.

Two general classes of these antifriction alloys are in common use: the first consisting of a soft matrix in which are embedded small particles of a hard alloy which has crystallized in the cooling of the molten mixture (see ALLOYS); the second, in which the hard constituent of the alloy forms a sort of network, in the meshes of which is contained the soft metal which reduces the friction. Four metals are in use as components of the antifriction or bearing metals, tin, lead, antimony and copper. Some special formulas call for zinc in addition, but it is generally argued that no benefit can be thus secured which cannot be better obtained by increasing the percentage of antimony in the mixture.

By far the larger number of the antifriction metals have a basis of tin as the soft matrix, the hard constituent being particles of tin-antimony and tin-copper alloys distributed throughout the matrix. Tin has the advantage of taking a high polish and this in itself serves to reduce friction. A cheaper class of these metals has a matrix of lead, or tin-lead, with tin-antimony as the hard constituent. Both of these are known as white-metal alloys. The class of bearing metals having a hard matrix with soft metal filling is known as plastic bronzes. They consist of a tin-copper alloy with sometimes a little zinc and occasionally nickel added, and may contain up to 30 per cent of lead. They are not as plastic as the white metals, but are more durable and better adapted for heavy pressures.

The original antifriction metal was invented by Isaac Babbitt in 1839, and was composed of tin 24 parts; antimony 8 parts; and copper 4 parts. A softer variety had 2 parts of antimony and 2 parts of copper to 24 parts of tin. The market was at once flooded with other combinations, good and bad, and all went under the title of Babbitt metal, and the name still remains in some markets, although the original Babbitt metal was long ago supplanted by more scientifically combined alloys.

For light-work bearings the formulas vary from 73 parts tin, 9 parts copper, and 18 parts antimony; to 85 parts tin, 5 parts copper, and 10 parts antimony.

For heavily loaded bearings: from tin 87 parts, copper 6 parts, and antimony 7 parts; to tin 90 parts, copper 2 parts, and antimony 8 parts.

For bearings of railway car axles: from tin 67 parts, copper 11 parts, and antimony 22 parts; to tin 83 parts, copper 6 parts and antimony 11 parts. The Pennsylvania Railroad uses a special plastic bronze, composed of copper 76.8 parts, tin 8 parts, lead 15 parts, and phosphorus 0.2 part. Another bronze highly recommended for railway bearings is composed of copper 64 parts, nickel 1 part, tin 5 parts, and lead 30 parts.

For locomotive axles a plastic brass is used: copper 5.5 parts, zinc 80 parts, and tin 14.5 parts.

For propeller shafts a plastic brass is composed of copper 57 parts, zinc 29 parts and tin 14 parts.

Ajax bronze, a plastic antifriction metal, has the composition: copper 81.2 parts, in 10.7 parts, lead 7.2 parts, and phosphorus 0.4 part.

The lead-antimony bearing-metals range in composition from: lead 65 parts, antimony 25 parts, and copper 10 parts; to lead 80 parts, antimony 15 parts, and copper 5 parts.

"Universal" bearing metal is composed of tin 6 parts, lead 77.75 parts, antimony 16 parts and bismuth 0.25 part. Consult Buchanan, J. F., 'Practical Alloying' (Cleveland, Ohio 1910); Gulliver, G. H., 'Metallic Alloys: Their Structure and Constitution' (London 1913); Law, E. F., 'Alloys and Their Industrial Application' (London 1909).

ANTIGO, ăn'ti-gō, Wis., county-seat of Langlade County, a northern county of the State. It is situated in the southwestern portion of the county, 96 miles north-northwest of Oshkosh and 207 miles northwest of Milwaukee; and it is on the Spring Brook River and the Chicago and Northwestern Railway. It is the commercial centre of an agricultural section of considerable importance, and of a timber region which has contributed largely to Wisconsin's position in marketed forest products. Here are located several extensive manufactures of various sorts, including chair, hub, broom-handle, excelsior, veneer and other factories; also foundries, breweries, railway-shops and flour, planing and saw mills. Antigo was settled about 1878, and in 1884 was incorporated; it has the commission form of government. The most noteworthy features of the thriving city include a teachers' training school, a school for the blind, a school chiropractic, a business college and a Carnegie public library. Altitude 600 feet. Pop. 7,196.

ANTIGONE. The subject of the 'Antigone' of Sophocles is that immortal heroine

> "who dares
> To self-selected good
> Prefer obedience to the primal law
> Which consecrates the ties of blood."

Though written in 441 B.C., many years before the 'Œdipus at Colonus,' the play treats of a later chapter in the story. It seems to have

been suggested by the last scene in the 'Seven Against Thebes' of Æschylus. At early dawn Antigone comes forth from the palace with her sister, Ismene, to talk with her alone about the edict of the king: will her sister join in her venture? "But Creon forbids." "He has no right to bar me." Thus the situation is unfolded at the very beginning — the conflict of wills between sovereign and subject. Ismene tries to dissuade her sister from the rash undertaking, but in vain. The chorus of elders enter to celebrate the day of deliverance that dawns on Thebes. Creon comes forth and addresses the nobles whom he has convened: "Eteocles shall be buried, but the corpse of Polyneices shall be left on the field, a prey for carrion kites to feed upon and for dogs to tear. Ally yourselves not with the rebellious." The heroic devotion of Antigone, burying her brother, Polyneices, and put to death for her pious disobedience of the tyrant's edict — that is the subject of the drama; and nothing could show more clearly the great originality of the poet's genius than his power to feel and to make others feel the grandeur of that subject. The superior beauty of the play is due primarily to the development of the character of Antigone. In the scene in which she and her sister, Ismene, appear together before Creon we find a happy example of the simultaneous employment of three actors. The rôle of Ismene reveals an innovation in dramatic art; in a manner truly Sophoclean the weaker sister is set over against the firmer Antigone. By reason of the skillful way in which the action is managed Sophocles has succeeded in extracting dramatic reversals of situation from a very simple subject; admiration, fear, sympathy, pity, indignation follow one another from scene to scene, even after the exit of the heroine.

The language of the tragedy is especially beautiful; and the martyrdom of the girl, who does not realize herself how noble her deed is, has commanded universal admiration. Antigone is a noble young woman, who feels that her act is right although she cannot advance arguments to justify that act. That she is truly feminine is seen in many a subtle touch. The character of Creon, the harsh tyrant, is also finely portrayed.

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ANTIGUA, antē'gwą, one of the British West Indian islands, situated lat. 17° 6′ N. and long. 61° 45′ W., about 50 miles east of Saint Kitts and the same distance north of Guadeloupe; area 108 square miles; dependencies Barbuda and Redonda, which have an area of 62 square miles; population including those dependencies 34,971 (mainly negroes) in 1901, as compared with 36,819 in 1891; the principal island of the Leeward group; residence of governor and his staff; port and chief town, Saint John; the chief products, sugar and pineapples. See ANTILLES; WEST INDIES.

ANTIGUA, La., city and municipality of Guatemala, and the capital of the department of Sacatepéquez. The municipality consists of the city proper, 8 villages and 13 hamlets. In the time of the Spanish domination it was the colonial capital. Destroyed in 1773, it still has remnants of past grandeur. Number of inhabitants in 1916 about 14,000.

ANTILLES, ăn-tĭl'lēz, name given both to the group of large islands forming the northern limit and the chain of small islands forming the eastern border of the Caribbean Sea. Practically all of the West Indian islands (see WEST INDIES), except the Bahamas are thus included. The Greater Antilles (Cuba, Jamaica, Haiti and Porto Rico) have about 6,700,000 inhabitants, or more than three-fourths of the entire population. The Lesser Antilles extend toward the southeast in a curved line from Porto Rico to the coast of Venezuela and follow the line of that coast from the Orinoco delta westward to the Gulf of Maracaibo. Their total area is about 5,500 square miles, and their population is approximately 1,307,000.

The following classification shows the natural grouping of the Lesser Antilles, with the area (in square miles) and the population of the islands in each of the groups: (1) *Virgin Islands.*— Saint Croix (A. 74, pop. 19,683); Saint John (A. 21, pop. 918); Saint Thomas (A. 23, pop. 10,000); Tortola (A. 58, pop. 4,222); Anegada (A. 13, pop. 300); Virgin Gorda (A. 176, pop. 417). (2) *Outer Chain of Caribbee Islands.*— Anguilla (A. 35, pop. 3,890); Saint Martin (A. 38, pop. 6,700); Saint Bartholomew (A. 8, pop. 2,650); Barbuda (A. 62, pop. 639); Antigua (A. 108, pop. 34,971); Désirade (A. 10, pop. 1,400); Marie Galante (A. 65, pop. 13,850). (3) *Inner Chain of Caribbee Islands.*— Saba (A. 5, pop. 1,909); Saint Eustatius or Saint Eustache (A. 7, pop. 1,408); Saint Christopher or Saint Kitts (A. 65, pop. 29,781); Nevis (A. 50, pop. 12,774); Montserrat (A. 32, pop. 12,215); Guadeloupe and dependencies (A. 600, pop. 212,430); Dominica (A. 305, pop. 28,891); Martinique (A. 400, pop. 194,000); Saint Lucia (A. 233, pop. 50,809); Saint Vincent (A. 150.3, pop. 45,605); Grenada (A. 133, pop. 69,307). (4) *Barbados.*— (A. 166, pop. 173,359). (5) *South American Islands.*— Tobago (A. 114, pop. 20,463); Trinidad (A. 1,754, pop. 352,145); Buen Ayre or Bonaire (A. 95, pop. 6,547); Curaçao (A. 210, pop. 32,959); smaller islands (A. 470, pop. 40,000).

English geographers call the northern part of the chain of Lesser Antilles "The Leeward Islands," the capital of the Leeward government being on Antigua, and the southern half "The Windward Islands," Grenada being headquarters of the Windward government. The present holdings of Great Britain, France, and Holland in the Lesser Antilles are reminders of the early struggles of the European nations to win supremacy in the New World; for the West Indies were commonly regarded up to the end of the 18th century as the most valuable part of America, and these islands were the chief battle ground of the rival powers. Admiral Rodney's victory over the French admiral De Grasse, 12 April 1782, gave England her commanding position in this region. Her possessions constituting several distinct colonial governments, include the Virgin group (except the American islands, Saint Thomas, Saint Croix, and Saint John); all below the centre of the chain, namely, Saint Lucia, Saint Vincent, Bardados, Grenada, Tobago and Trinidad; the important island of Dominica, etc. The Virgin Islands are important because they command the deep-water Anegada passage between the Atlantic Ocean

and the Caribbean Sea; and the only deep harbors (except Saint Thomas) in the Lesser Antilles are in Trinidad and Saint Lucia. The French retain among their possessions the somewhat larger islands of Guadeloupe and Martinique in the centre of the chain. The Dutch, in addition to Curaçao and Buen Ayre, have a part of Saint Martin and a few small islands below the Anegada Passage, the whole width of the Caribbean Sea intervening. The economic history of the islands of the Lesser Antilles is simple. Nearly all of them derived their wealth in the past from sugar culture, and with the decline in the price of sugar have sunk into poverty. Meanwhile, the black population has crowded out the Caucasians. The increase in the population of the Greater Antilles since the early years of this century is decidedly noteworthy.

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MARRION WILCOX.

ANTIMASONRY. In the United States history, (1) the widespread hostility to the Freemasons, as an order whose oaths were claimed to be superior to public duty and private morality, excited by the fate of William Morgan (q.v.) in 1826. He was a broken Virginian, who had settled in Batavia, N. Y., about 1824, as a mason by trade, and professing to be a Royal Arch Mason; and in the summer of 1826 was reported to be writing a book to expose the secrets of Freemasonry, to be printed at a local newspaper office. Though the Masons were naturally indignant and distressed, the other citizens regarded it as a catchpenny scheme and had Morgan remained in view probably Masonry would have suffered little damage,— certainly none if the Masons had merely denied his statements, for his word would have carried no weight. But, unluckily, just at this time suits against him for debt began suddenly to multiply and bail was either refused or disregarded. Finally on 11 August he was taken to Canandaigua, 50 miles away, on a charge of theft; was released, but at once rearrested for debt; and on the next night, being again released, he was at once seized and never reappeared. The public at once connected this with the Masonic exposure and threats, and vigilance committees were shortly organized which traced him beyond question, in the hands of abducting parties, to Fort Niagara, an unoccupied United States post at the mouth of the Niagara River; the last ever certainly known of him, though other statements made it seem probable that he had been murdered and thrown into Lake Ontario. The excitement, increased by the belief that prominent Masons obstructed the investigations, was fanned into flame by the appearance, a few weeks later, of the first part of Morgan's book, the other parts ultimately being published also; entitled 'Illustrations of Freemasonry, by One of the Fraternity Who Has Devoted Thirty Years to the Subject'; reprinted under various titles, as 'Light on Masonry,' 'Freemasonry Exposed and Explained,' etc. Along with a mass of dreary "ritual" for "working the degrees," of no moment even if true, and its betrayal a scandalous violation of good faith, it included some passages which if true would have obligated him to make them known at once on joining: such as an oath requiring Masons to place their duty to a brother Mason before their oaths in court; and others pronouncing dire vengeance (graduated according to the degree thus betrayed) on Masons who should reveal the secrets of the order, and obligating every "brother" to make it his business to execute the threat. The denials of the Masons were not thought categorical enough. The alleged agents in the abduction were put on trial between January 1827 and 1830, and several were convicted and sentenced, some pleading guilty to save examination as to conspiracy. They could not be held for murder, but popular judgment charged that crime to the fraternity if not to the individuals. Very soon Antimasonry had become the one issue of the day. Candidates for local office who refused to withdraw from the order were heavily "scratched" at elections, and great numbers of lodges had to give up their charters and dissolve. From New York the feeling spread through the Union, and more than 3,000 lodges surrendered their charters before the storm blew over. The governor of New York and a large number of the leading officials and prominent public men were Masons, as now; but in the campaign of 1828 the National Republicans dared not nominate any who belonged to the order. None the less the Antimasons formed a regular party, holding a convention at Utica and nominating Solomon Southwick for governor. William H. Seward, Millard Fillmore and Thurlow Weed first came forward as Antimasonic candidates. A body was conveniently found in Niagara River and said to be Morgan's, though of course unrecognizable; and Weed is credited with having replied, when questioned as to its authenticity, that it was "a good enough Morgan till after election." The ticket polled 33,345 votes out of 276,583; but it polled some 70,000 in 1829 and 128,000 in 1830; the National Republican party in the State was gradually absorbed and became chief anti-Democratic organization. This is the most singular feature of the whole movement; for the National Republicans, like the Whigs and Republicans later, were distinctly the party of the upper business and professional classes, which were the very ones who formed the strength of the Masons. Yet the same result obtained everywhere: doubtless it was due to the accidental fact that Jackson, the idol of the Democracy and then President, was a Mason. A national convention was held in 1830 to organize a national party; and in

September 1831, in order to force Clay, who was a Mason, out of the field, it held a convention (in Baltimore) before any of the other parties, and nominated William Wirt of Maryland and Amos Ellmaker of Pennsylvania for the Presidency. The National Republicans, however, supported Clay, and in the election of 1832 Wirt received only the electoral vote of Vermont. The party took no further national action, and with the National Republicans was soon absorbed in the new Whig party, though it retained force enough to compel the Whigs to discard Clay for Harrison in 1833 and 1839. In Pennsylvania, however, allied with the Whigs, it survived till about 1840 and elected a governor, Joseph Ritner. (2) Another Antimasonic body was formed in 1868 as the National Christian Association, at Pittsburgh, Pa., though hostility to Masonry was only one of its tenets; it renamed itself in 1875 the American Party (q.v., No. 2), and entered politics. It opposed Freemasonry as "false religion and false politics," and urged the prohibition of oath-bound lodges as acknowledging another government than that of the United States.

Bibliography.—For Morgan, consult Morris, 'History of the Morgan Affair' (1852); Greene, 'The Broken Seal, or the Morgan Abduction and Murder' (1870). For political results, Hammond, 'Political History of New York;' Hopkins, 'Political Parties' (1900).

ANTIMISSION BAPTISTS (their own title is "Old School Baptists"), an American sect founded about 1835, who do not believe in Sunday-schools or theological seminaries, holding that salvation does not depend upon human instrumentalities, but upon divine grace alone.

ANTIMONAN, ăn'tę-mō-năn', a seaport town of Luzon, Philippine Islands, province of Tayabas. It is situated on Lamon Bay, about 100 miles southeast of Manila. Pop. about 11,000.

ANTIMONOPOLY PARTY, an American political organization which in 1884 nominated for the Presidency Benjamin F. Butler (q.v.), on a platform advocating election of United States senators by popular vote, an income tax, the repeal of all tariffs, and the prohibition of land grants to corporations. It united with the Greenback Labor party, the combined vote reaching 130,000 votes in the November election of 1884.

ANTIMONY, one of the metallic elements. It is found in nature in the metallic state, but its chief commercial source is the mineral stibnite, which is a sulphide of antimony (Sb_2S_3). Considerable of the metal is produced as a by-product in the smelting of lead-silver ores. The mineral stibnite occurs in veins, commonly associated with other metallic minerals. Stibnite was known in very early times. It has been used by the women of the East for many centuries for painting the eyebrows and eyelashes and giving lustre to the eyes. Before the discovery of the metal itself, stibnite was called "antimony," and it appears that the paint used by Jezebel (2 Kings ix, 30) was finely ground stibnite. The Arabs called this face-paint *al Koh'l* (compare ALCOHOL). The first distinct mention of the metal itself is made by Basil Valentine, who gives a process for extracting it from stibnite, though he does not claim to have discovered it. Several methods for extracting it are now in use, chief of which is the following: Two parts of stibnite are melted with one part of thin scrap iron, in plumbago crucibles. The sulphur, leaving the antimony, combines with the iron, so that sulphide of iron and metallic antimony result, the iron sulphide floating as a slag. The crude antimony so obtained is next melted with a small amount of sulphate of soda and a little of the slag obtained from the operation next to be described. By this means the metal is purified somewhat. It is then cast into molds, and when cold is broken up into small pieces, to prepare it for the third operation, which is called "melting for star metal." This last-named process consists in melting 60 parts of the broken metal with two parts of pearlash and five parts of slag from a previous operation of the same kind. The resulting metal or regulus is poured into square molds, into which some slag has first been allowed to run, and is cooled slowly while still covered with slag. If the metal is of good quality, the resulting blocks will have a stellated or crystalline surface.

Antimony is a brilliant, bluish-white, brittle, crystalline metal, with a specific gravity varying from 6.72 to 6.86. It melts at about 800° F., and if protected from the air boils at a white heat. At ordinary temperatures it is not acted upon by air or water, but it oxidizes quickly when melted, and at a red heat burns at a brilliant white flame, and can decompose water. It expands upon solidifying, and imparts this property to its commoner alloys. Its coefficient of expansion is about .0000064 per degree F. The tensile strength of cast antimony is about 1,000 pounds per square inch of sectional area. It is a comparatively poor conductor of heat and electricity, its thermal conductivity being only about 1/25 of that of silver; its electrical resistance is 0.488 of that of mercury at 32° F., and 0.704 that of mercury at 212° F. Its chemical symbol is Sb (from the Latin word *stibium*), and its atomic weight is sensibly 120. It is diamagnetic; that is, a sphere made from it is repelled by a magnet, though the repulsion is hardly comparable in magnitude with the force of attraction that a magnet exerts upon iron. It also has marked thermo-electric properties, and is used in the laboratory in the construction of thermopiles. Antimony forms valuable alloys with other metals, and this is its most important use in the arts. Type metal is an alloy of lead, antimony, and tin, with sometimes a little copper. The tin adds toughness, while the antimony gives hardness and causes the alloy to expand at the instant of solidifying, giving a sharp cast of the letter. In the manufacture of munitions of war antimony plays an important part. It is employed to give to shrapnel bullets the hardness through which they retain their spherical shape when the shell explodes. Previous to the European War the annual production of metallic antimony in the United States was between 2,000 and 3,000 tons — obtained mainly from antimonial lead. With the growth of the munition making industry the demand for the metal increased rapidly, and in 1915 the total production reached 18,600 tons. About 5,000 tons of this total was produced in domestic mines in Inyo, Kern and

San Benito counties of California; in Humbolt and Elko counties of Nevada; and at points less notable in Arkansas, Idaho, Montana, Oregon, Utah and Washington. A larger degree of interest, however, attached to the output of Alaska, amounting in that year to 1,390 tons of stibnite, carrying nearly 60 per cent of metallic antimony from this entirely new source. A large factor in the total was 8,500 tons from China. South America and Mexico supplied nearly all the rest. The antimony prospects of Alaska are considered most promising, and the showing for 1916 should be much larger, when the smelter returns have been compiled. Besides the localities mentioned, antimony is found in France, Australia, Japan, China, Italy, Spain, Portugal and South Africa. See ELECTRO-CHEMICAL INDUSTRIES.

ANTIMONY-POISONING, a variety of poisoning formerly more common than at present. The mortality is about 40 per cent. The symptoms of acute poisoning resemble closely those of arsenic-poisoning. There is sudden acute gastric pain, with nausea and vomiting, pressure in the breast and intense sense of anxiety. This is followed by colicky pains and diarrhœa. The pulse becomes small and frequent, later retarded; the respirations diminish in number, the skin is cyanotic, the temperature sinks and coma and convulsions lead to death. If vomiting develops early, before time has elapsed to permit of the absorption of a large amount of antimony salt, death is less likely to occur. The treatment should include washing out the stomach, inducing of vomiting and the use of tannic acid compounds.

ANTINEBRASKA PARTY. See KANSAS-NEBRASKA BILL.

ANTINOMIANISM, the name applied to the doctrine that the dispensation of grace as set forth in the New Testament frees the Christian from the claims and obligations of the moral law as presented in the Old Testament. In the early Church there were antinomian tendencies due to an over-emphasis of faith in opposition to works. This is especially so in some of the Gnostic systems, where faith and love are so emphasized and moral matters appear indifferent, and the contradictions between the law and the gospel are regarded as irreconcilable. Antinomianism marked many of the mediæval sects, but reached its fullest development in the Reformation period. In Luther's emphasis on the doctrine of justification by faith he had used expressions which might be understood to indicate opposition between the law of Moses and the gospel, as though with the establishment of the gospel the law of Moses was no longer of any value. But when Luther carefully expressed himself on this point, as he did in his instruction to the Saxon preachers in 1527, he gave to the teachings of the Old Testament their proper place in the Christian life. This was disputed by Agricola, and a controversy broke out between him and Luther, in which he treated Luther's most extreme statements in regard to faith as though they were to be taken literally. His follower Amsdorf went as far as to say that good works were detrimental to salvation. In England there were Antinomians in the various sects in the time of Cromwell. They were high Calvinists and claimed that, as the elect cannot fall from grace, any act performed by them, however sinful it may seem to men, is not in reality sinful.

ANTIOCH (Latin, *Antiochia*), the ancient capital of the Greek kings of Syria; on the Orontes, about 21 miles from the sea. It was founded by Seleucus Nicator in 300 B.C., and named after his father Antiochus. The first inhabitants were brought from Antigonia, founded by Antigonus in 307. It was famed for the splendor of its public buildings, the Seleucid monarchs having vied with each other in embellishing their metropolis, and the Roman emperors having also done much to adorn it. It was called the "Queen of the East" and "The Beautiful," and was advantageously situated for trade, being easily approached by the caravans of the East, and through its port Seleucia having maritime communication with the West. The city is frequently mentioned in the New Testament, and it was here that the disciples of our Saviour were first called Christians (Acts xi, 26). In 64 B.C., on the breaking up of the kingdom of Syria, it was captured by Pompey; in 266 was captured bv the Persians under Sapor; and in 538 was thrown into a heap of ruins by Persians under Chosroes. It was restored by the Emperor Justinian, but never quite recovered from this last blow. In the first half of the 7th century it was taken by the Saracens and remained in their possession for upward of 300 years, when it was recovered by the Greek Emperor Nicephorus Phocas. In 1098 it was taken by the Crusaders. They established the principality of Antioch, which lasted till 1268, when it was taken by the Mameluke Sultan of Egypt. In 1516 it passed into the hands of the Turks. The modern Antioch or Antakieh is a poor place. It has some manufactures of silk stuffs, leather and carpets, and has some trade in these articles and in goat's wool, beeswax, etc. The population is not far from 20,000.

ANTIOCH, Cal., town of Contra Costa County, on the south bank of the San Joaquin River, on the Southern Pacific and the Atchison, Topeka and Santa Fé railroads, 40 miles northeast of Oakland. Its industries comprise paper mills, potteries, shipyards and planing mills. It has two banks with total resources of $1,200,000 and a total property valuation of $900,200. The principal buildings are the town hall, the grammar school and Union High School. For the fiscal year ended 30 June 1917 the town's receipts amounted to $24,736.23 and expenditures to $24,191.37. The government is vested in a board of five trustees. Pop. about 2,500.

ANTIOCH COLLEGE, an American co-educational institution in Yellow Springs, Ohio, founded in 1852 with Horace Mann as its first president. It has an endowment of over $100,000; its grounds and buildings are valued at $250,000; and its library contains 12,000 volumes. In 1917 it had 20 instructors and 253 students.

ANTIOCHUS, the name of 13 kings of Syria: 1. ANTIOCHUS I, or ANTIOCHUS SOTER, son of Seleucus: b. about 324 B.C.; d. 261 B.C. He succeeded his father in 280 B.C. and disputed Macedonia with Antigonus Gonatas, but finally relinquished it to him. During the greater part

of his reign he was engaged in a protracted struggle with the Gauls, by whom he was killed in battle. 2. ANTIOCHUS II, or ANTIOCHUS THEOS, who succeeded his father Antiochus I. Weakened by war with Egypt, he lost Parthia and Bactria by revolt. He was murdered in 246 B.C. by Laodice, his wife, whom he had put away to marry Berenice, daughter of Ptolemy. 3. ANTIOCHUS III, THE GREAT, grandson of Antiochus II, who succeeded his father Seleucus Callinicus in 223 B.C. at the age of 15. He made war on Parthia and Bactria, but was compelled, after a long war, to recognize the independence of these kingdoms. He next invaded India, where he remained for seven years (212–205 B.C.). Invading Asia Minor and crossing to Europe he took possession of the Thracian Chersonese. Antiochus gained an important ally in Hannibal, who had fled for refuge to his court; but lost the opportunity of an invasion of Italy while the Romans were engaged in war with the Gauls, of which the Carthaginian urged him to avail himself. In 192, at the request of the Ætolians, he crossed to Greece, but was defeated by the consul Acilius Glabrio and returned to Asia. He was defeated by Scipio near Magnesia, 190 B.C. Peace was granted him in 188 B.C. on the cession of all his dominions west of Mount Taurus, with a heavy indemnity. He also engaged to surrender refugees of his court, but he allowed Hannibal to escape. He was killed while plundering a temple in Elymais. 4. ANTIOCHUS IV, EPIPHANES, son of Antiochus the Great; d. 164 B.C. He is chiefly remarkable for his attempt to extirpate the Jewish religion. 5. ANTIOCHUS V, EUPATOR, son of Antiochus IV, who reigned from 164 B.C. to 162 B.C. 6. ANTIOCHUS VI, THEOS, ruled for three years, 145–142 B.C. 7. ANTIOCHUS VII, SIDETES, the son of Demetrius I: b. about 164 B.C.; d. 129 B.C. He defeated the Parthians in several battles. 8. ANTIOCHUS VIII, GRYPUS, son of Demetrius II. He ruled 125–113 B.C. and 111–96 B.C. and was slain by Heracleon in the last named year. 9. ANTIOCHUS IX, CYZICENUS, son of Antiochus VII. Defeated in battle against Seleucus V, he committed suicide in 95 B.C. 10. ANTIOCHUS X, EUSEBES, son of Antiochus IX. He reigned but three years and was obliged to flee to Parthia in 92 B.C. II. ANTIOCHUS XI, EPIPHANES, son of Antiochus Grypus. He reigned 95–93 B.C. and was drowned in the Orontes. 12. ANTIOCHUS XII, DIONYSIUS, 85 B.C. He was killed in battle with the Nabatoreans. 13. ANTIOCHUS XIII, ASIATICUS, the son of Antiochus X, and the twentieth of the Seleucidian dynasty. Beginning his reign in 69 B.C. he was deposed by Pompey in 65 B.C.

ANTIODACTYLA, the suborder of ungulate mammals that includes the "split-hoofed" animals — cattle, deer, antelopes, sheep, etc.— in which only the third and fourth toes bear the weight of the body. See UNGULATA.

ANTIOQUIA, ăn'tē-ō'kē-ą, a department of the republic of Colombia, South America, embracing 24,401 square miles and divided into the provinces Centro, Oriente, Aures, Fredonia, Suroeste, Nordeste, Norte, Sopetrán, Occidente and Uraba. The inhabitants are successful both in mining and in agriculture. The departmental capital is Medellin; and as a well-informed writer tells us, that city is not only the most important trading centre in Colombia, but is also noteworthy for its manufactures. "The population," he adds, "is not quite 70,000, but its wealth is out of all proportion to the number of inhabitants." There are few, if any, cities of its size in the whole of South America that rival it in wealth. Population of the department (1896) 648,190; (1911) 741,816; (1916) 776,000.

ANTIPHLOGISTIC, a term applied to medicines or methods of treatment that are intended to counteract inflammation, such as bloodletting, purgatives, diaphoretics, etc.

ANTIPHONY ("alternate song"), a term denoting in the services of the Christian Church, a psalm, chant or other composition, sung by two parties in alternation, as by two choirs or parts of a choir, or first by a single voice and then repeated by the whole choir. The Roman Church applies the term antiphony in a restricted sense to a series of "words or verses prefixed to and following a psalm or psalms, to express in brief the mystery which the Church is contemplating in that part of her office." The practice of alternate singing formed a part of the old Jewish worship. Its introduction into the Christian Church is ascribed to Ignatius in the 1st century after Christ. The Western Church is said to have received it more particularly from Saint Ambrose.

ANTIPODES, ăn-tĭp'ō-dēz (from the Greek *anti,* against, and *pous,* a foot), the name given to inhabitants of the earth diametrically opposite to each other, and of course literally applied to those who turn their feet toward each other; or to any part of the earth's surface situated diametrically opposite any given part. The antipodes live in similar and, except at the equator, opposite latitudes, and their longitudes differ by 180°. Hence the difference in their time is about 12 hours, and their seasons are reversed. The spherical form of the earth naturally leads us to the idea of the antipodes, of whose existence some idea was entertained even before the age of Cicero.

ANTIPODES ISLAND, a small uninhabited island in the south Pacific Ocean, about 460 miles southeast-by-east of New Zealand; so called from being nearly antipodal to Greenwich, England. Its area is about 11 square miles.

ANTIPOPE, a pontiff elected in opposition to one canonically chosen. The first antipopes were: Felix, during the pontificate of Liberius (352–66) and recognized during the absence of Liberius; Ursinus, against Damasus (366–84); Eulalius, against Boniface I (418–22); Laurentius, against Symmachus (498–514); Dioscurus, against Boniface II (530–32); Vigilius, against Sylverius, until 540, then canonical; Constantine, against Paul (767); Anastasius, against Benedict III (855); John XVI, Philogathus, against Gregory V (996–99); Gregory, against Benedict VIII (1012–24). During the middle ages several emperors of Germany set up Popes against those whom the Romans had elected without consulting them. Otho the Great displaced successively two bishops of Rome; and when the rival Pope, Sylvester III, had expelled the simonia-

cal and profligate Benedict IX (1033–45), the latter was brought back by the German King, and soon afterward relinquished his dignity in consideration of a large tribute. Gratianus, who had persuaded him to yield, was now named Pope by the Romans as Gregory VI. There were, consequently, three Popes, but their claims were all set aside at a council convened at Sutri by the Emperor, Henry III, and a new Pope elected as Clement II in 1046. Shortly after, Pope Alexander II found a rival in Honorius II, the nominee of the Emperor; but his claim was ratified by a council convened at Mantua. In 1080 the same unseemly spectacle was witnessed, when the Emperor Henry IV elevated to the papal chair Guibert of Ravenna, under the title of Clement III, in opposition to his own implacable adversary, Gregory VII. After the death of Gregory (1085), Clement was antipope successively to Victor III (1087–88) and Urban II (1088–99). Other antipopes at this period were Albert, Theodoric, Maginulf, all in one year (1100–01); Maurice Burdin, against Gelasius II (1118–19) and Calixtus II (1124–30). Innocent II (1130–43) triumphed over the antipope Anacletus II by the help of Saint Bernard; and Alexander III, during his pontificate (1159–81), had to contend with three successive antipopes, the election of only one of whom, however, Victor IV, in 1159, has any appearance of canonical validity. The others were named Pascal III (1168) and Calixtus III, the same year. After a long contest Clement V was elected in 1305, and four years later transferred his seat to Avignon, where his successors reigned for nearly 70 years, losing the while, by their subjection to French influences, the sympathies of Germany and England. Nicholas V (1328–30) was antipope against John XXII. The election of Urban VI in 1378 occasioned "the great schism of the West," which divided the Church for 50 years. He was elected by the Romans, who demanded an Italian Pope after the death of Gregory XI. The French cardinals, then a majority in the curia, on the plea that they had elected the Pope only under intimidation, withdrew to Provence, and elected an antipope under the name of Clement VII, who was recognized by France, Spain, Savoy and Scotland; while Italy, Germany, England and the whole north of Europe supported Urban VI. For 38 years Christian Europe was scandalized by the spectacle of two Popes, one at Geneva, another at Rome, in turn hurling the most awful anathemas of the Church at each other. At the beginning of the 15th century an attempt was made to prevail on both the rivals, Gregory XII at Rome, and Benedict XIII at Avignon, to renounce their claims with a view to promote union, but both evaded this as long as possible. At length, however, the cardinals attached to either court agreed to summon a general council, which met accordingly at Pisa in 1409. The council deposed both Popes and constituted the separate bodies of cardinals into one conclave which elected Alexander V to the papal chair. The schism was finally healed when the council of Constance deposed John XXIII, and Gregory XII and Benedict XIII agreed to abdicate and recognize as Pope Martin V, against whom Peter de Luna and Munoz of Barcelona were antipopes. The council of Basel (1431–47), in its struggle with Pope Eugenius IV (1431–47) for supremacy, attempted to arrogate to itself the papal functions and proceeded to elect Amadeus of Savoy Pope as Felix V. The attempt, however, failed; the Popes Eugenius IV and Nicholas V (1447–55) secured their authority, the ambitious council finally dissolved itself and Felix V resigned his empty dignity and was raised to the rank of cardinal by the magnanimous Pope himself. This was the last occasion on which the faithful were distracted by the sight of a rival pontiff within Christendom.

ANTIPYRETICS, the name given to remedies employed to reduce temperature in diseased conditions. Direct application of cold in the form of baths, packs, ice-cloths, etc., are the most valuable and efficient antipyretics. In some definite affections, notably in malaria, quinine, by destroying the parasite that causes the disease, reduces the temperature. Of late years a large number of synthetic drugs have been introduced to be used for the purpose of reducing temperature in disease. These are more technically the antipyretics. The field of their usefulness in this particular function, however, is constantly narrowing, since it is being recognized that fever is only a symptom and often not a dangerous one at that. Rational therapeutics would first eliminate the cause of fever, and drugs are then rarely necessary. The more important drug antipyretics are antipyrin, opium, quinine and its allies, salicylic acid and its compounds, alcohol, chloral, squills, phenacetin, acetanilide and others of the modern analgesics (q.v.). The most important of the functions of most of these drugs is their power to relieve pain. Their antipyretic action is often extremely complex — in general they diminish oxidation, increase perspiration or diminish the force and frequency of the heart-muscle contractions. See ANALGESICS; ANIMAL HEAT; FEVER.

ANTIPYRIN, the trade name of an artificial alkaloidal substance known to the chemist as oxydimethyl-quinizin, or, more accurately, as oxy-phenyl-di-methyl-pyrazole. It is a crystalline substance melting at 235° F. and soluble in water, alcohol, ether, and chloroform. Antipyrin is a derivative of coal-tar, an organic nitrogenous basic compound with the composition $C_{11}H_{12}N_2O$. It forms colorless scaly crystals devoid of odor and with a slightly bitter taste. It is soluble in water, alcohol and chloroform. It is one of the first of the modern army of synthetic drugs, and is still one of the most valuable, though not so extensively lauded as formerly, the patent on its exclusive production by one manufacturer having expired in 1899. Its action locally is somewhat antiseptic, and solutions applied to mucous membranes render them slightly anæsthetic and contract the blood vessels. It therefore makes a good local application to catarrhal membranes. Taken internally it is readily absorbed, reduces the force and frequency of the heart action, causes a dilatation of the blood-vessels of the periphery of the body, thus bringing about sweating and increased heat elimination (see ANIMAL HEAT). Its chief antipyretic action is due to the co-ordinating mechanism which lowers the heat at the point where the temperature is maintained and accumulated (the skin); the dilatation of the capillaries brings about the dissipa-

tion of this accumulation, which vascular dilatation is caused by the action of the heat-regulating mechanism possibly situated at the base of the cerebrum. Antipyrin is also an efficient and valuable analgesic, particularly serviceable in headache, neuralgias, in dysmenorrhœa, in rheumatism and in affections of the peripheral nerves and joints generally. By its pain-relieving qualities it makes a valuable adjunct in hypnotic mixtures. It is also a good antispasmodic.

Antipyrin is mainly eliminated by the kidneys. It may cause symptoms of poisoning. These are collapse, cold extremities and some degree of cyanosis and heart weakness. It is not one of the aniline (q.v.), analgesic antipyretics and hence has not the characteristic blood-poisoning properties of the anilines (acetanilide exalgen, mathacetin and similar bodies). It may produce a number of untoward symptoms, notably skin eruptions, cramps of the intestine and of the bladder. It also may cause disturbances of sensation in the extremities. Doses of from 10 to 15 grains have caused serious symptoms of poisoning, particularly in children. See ANALGESICS; ANTIPYRETICS.

ANTIQUARIES, persons devoted to the study or collection of antiquities. In most of the countries of Europe and America there are important associations of antiquaries. The object of these societies is the collection and preservation of ancient manuscripts, inscriptions, coins, sculptures, etc.; the examination of ancient edifices and other remains; in short, the investigation of everything likely to throw light on the manners, customs and history of the past. The chief antiquarian society of Great Britain is the Society of Antiquaries of London, founded in 1572, revived in 1707 and incorporated in 1751. The president for the time being is an official trustee of the British Museum.. It has published 'Archæologia' (1770, etc.), 'Vetusta Monumenta' (1747), and 'Proceedings' from 1849. The Society of Antiquaries of Scotland was founded in 1780 and incorporated in 1783. The Archæological Institute of Great Britain and Ireland, established in 1843, is a society of similar character. The American Antiquarian Society was organized in 1812.

ANTIQUARY, The, a romance by Sir Walter Scott (1816). It is weak in its supernatural machinery, but strong in dialogue and humor. The plot centres about the fortunes and misfortunes of the Wardour and Glenallan families, and the chief character is Mr. Jonathan Oldbuck, the Antiquary, whose odd sayings and garrulous knowledge are inimitably reported.

ANTIQUES, a term specifically applied to remains of ancient art, such as statues, paintings, vases, cameos, and the like, and more especially to works of Grecian and Roman antiquity.

ANTIQUITIES OF THE JEWS, The, a famous work by the historian Flavius Josephus, concluded in the 13th year of the reign of Domitian. It was addressed especially to the Greeks and the Gentiles.

ANTIQUITY, a term generally denoting the time prior to the irruption of the barbarians into the Roman empire in the middle of the 5th century, or previous to our era. In a narrower sense it is applied to the period over which the ancient history of the two principal nations of former times, the Greeks and Romans, extends. The name antiquities is commonly given to the remains of ancient art and industry, such as tools, weapons, sculptures, inscriptions, etc. It is also used in a wider sense to signify anything appertaining to a knowledge of the politics, manners, religion, literature and arts of the nations of antiquity, or of the modern nations, until the existing order of things commenced. See ARCHÆOLOGY.

ANTIRENT AGITATION, in New York State. Although the manorial system of large landed estates with leasehold tenants disappeared early in all other parts of the northern States of the Union, it flourished vigorously along the Hudson and Mohawk until well into the 19th century. This was due probably to the high personal qualities and tenacious landlordship of the Van Rensselaer and Livingston families, and the desire they inspired in others to become semi-feudal country gentlemen of the same stamp. The greatest of these holdings was the Van Rensselaer patroonship, called Rensselaerswick, derived from a Dutch grant confirmed by James II; originally comprising the entire counties of Albany, Rensselaer and Columbia,—20 miles on each side of the Hudson,—and to the last retaining many hundreds of large farms in them. Almost as large was the "Livingston Manor," at one time holding 162,000 acres in Dutchess and Columbia counties. The extensive Hardenburgh Patent, dating from 1749, occupied large sections in Greene and Delaware counties; and there were many other considerable estates. The tendency in the vicinity of these great manors was not to sell farms, but lease them with feudal incidents, in imitation of their great neighbors; so that in 8 or 10 of the east-central counties a large part of the land was in tenant farms, mingled with and surrounded by properties in fee. There were some very annoying provisions in some leases; one for giving the landlord a quarter of the proceeds of the sales of produce in case of alienation of the fee, making the landlord a partner with a one-fourth interest. In practice this provision was either not enforced or was commuted for a fraction of the value, and in the Hardenburgh Patent, where was the fiercest resistance and the most bloodshed, there was no such provision at all; but it served as a common grievance whether present or absent. Also rents were often in kind, fixed or shares, which is always fertile in heartburnings; many, however, had been commuted to money. But the actual grievances were slight, and the tenants were probably better off in income than the owners in fee. In Rensselaerswick the first seven years of a lease were usually rent-free; on the Hardenburgh Patent five years, with the next five at half rent; and arrears and reservations were very laxly enforced, often not at all for years,—which was injudicious charity and produced the crisis, as enforcement of back dues meant being sold out and evicted, and agriculture is the one employment that will not endure that from private owners. The insecurity of the old feudal tenures had been removed by the legislation of 1779 and 1789, which abolished them; and the new leases, though having the same rentals and services, were in fee, so that raising of rent and confiscation of im-

provements were impossible. Further legislative regulation was attempted in 1812 to settle the respective rights of patroons and tenants; but the friction continued, and naturally involved all other land dealings,—contracts, mortgages, etc., having as ill an odor as leases. In 1836 a mob in Chautauqua County destroyed a land office with its records, on a rumor that the mortgages were to be foreclosed; and the same thing was only prevented at Batavia by an armed gathering of the townsmen. The matter was brought to a head by the death of Gen. Stephen Van Rensselaer, the eighth patroon of Rensselaerswick. This fine old gentleman, who commanded at Queenstown Heights and founded Rensselaer Polytechnic Institute, died early in 1839, leaving over $200,000 of uncollected rents and any number of unenforced quarter-sales, and two heirs to whom he left his estates on the respective sides of the Hudson. These heirs undertook to collect the arrears and enforce the rights left in abeyance; and the tenants formed associations to resist. The first to do so were those in the Helderberg Mountains, west of Albany (whence the disturbance is sometimes called the Helderberg War); but those east of the Hudson in Rensselaer County outdid them by forming a mob in disguise and murdering a man. The counties were in open rebellion, and in December Gov. William H. Seward issued a proclamation against the rioters. The sheriff of Albany County with a posse several hundred strong was stopped by 1,500 armed men; a company of militia was called out, but was forced back by a gathering of nearly 1,000, and at last a body of about 1,000 militia had to be sent to Albany. The executions were finally levied, and on the 12th the soldiers were sent home. On the governor's recommendation the legislature appointed a commission to report on a plan of adjustment; but as the only parties who wished the legal status quo changed were the tenants, the landlords considered the concessions to be all on their side and refused to listen to its recommendations. A stubborn resistance practically nullified the collection of rents year after year. At length in 1844 the rebellion broke out with tenfold violence, in a general organization through Rensselaer, Schenectady, Columbia, Otsego, Delaware, Ulster, Greene, Dutchess and other counties, against the payment of any rent whatever, and to compel the lords of the manor to sell their lands to the persons occupying them as tenants. The justifications legal and equitable may be surmised: that the landlords had no title, that the rent had been waived, that the payment of rent was against republican institutions, etc. A regular agrarian war was instituted: the tenants, plus all the rabble who liked to commit outrage on any side, disguised themselves as Indians and began a reign of terror, flogging, tarring and feathering, boycotting and generally ill-using all who took leases, or in any way dealt with landlords. One laborer who had bought lumber from a leased farm and was taking it to market was shot dead by a mob in a struggle to take it from him. At length, on 7 Aug. 1845, a deputy sheriff of Delaware County was fatally shot by such a mob while serving a process; the extortion which called for this bloodshed was two years' back rent at $32 a year. These performances went on for months; Gov. Silas Wright, who in his message of 1845 had favored commutation of rents and ownership in fee though calling for sharp laws to punish outrages, now summoned a military force and sternly put down the rebellion. More than 50 convictions were obtained, two of murder with sentence of death, which the governor commuted to imprisonment for life; but in his next year's message (1846) he recommended the abolition of distress for rent and the limitation of leases to 5 or 10 years. The constitutional convention of 1846 abolished feudal tenures and limited leases to 12 years. This was not at all what the Anti-renters wanted, however, but abolition of rent altogether and proclamation of the lease-holders as owners. Their cause had been an issue in State politics for years, fomented by agitators and newspapers; and the Whigs, seeing that they controlled the legislative delegations of 11 counties, nominated for governor in 1846 their chief legislative champion, John Young, against Silas Wright, elected him by their aid, and he promptly pardoned all those who had been sentenced, pronouncing their offenses "political." He also recommended State suits against landlords to try titles. The Anti-renters had "adopted" a part of the State ticket and not the rest, to show their strength, and polled about 5,000 votes; the next election (of 1848) they did the same: and the legislature, alive to the value of this body of votes, directed the attorney-general to bring a test suit against Harmon Livingston. The decision in November 1850 was for Livingston; but the nearly 12-years struggle and ruin of property values had wearied the landlords, and the decent tenants were perhaps ashamed of their breach of contract. The former offered to sell the farms, and the latter were willing to buy; and the great patroonship and patents were rapidly broken up. Meantime there was a mass of private litigation, and several cases went up to the Court of Appeals; which in October 1852 declared that without reference to the Constitution of 1846, agreements in restraint of alienation of titles in fee, and therefore reservations of quarter-sales, were void. As this left the landlords no right which could oppress the tenants, and the latter nothing to oppose except a payment of honest debts, the Antirent agitation passed out of sight as a dignified political entity. But the spirit was not quite dead. As late as July 1866 an antirent riot broke out in Knox, Albany County, which had to be suppressed by the militia. The next month a landowner's agent in Berne was fired at and his horses were shot. These, however, were belated estrays: for a generation land contracts have been on a footing with all others. Consult Alexander, 'Political History of the State of New York' (Vol. II, New York 1906); Jay Gould, 'History of Delaware County' (1856); Roberts, 'History of New York' (1887); Cheyney, 'Anti-Rent Agitation' (Philadelphia 1887); Wright, 'Life of Governor Silas Wright' (Auburn 1847); Murray, "Anti-Rent Episode in New York" in 'Report of the American Historical Association' for 1896.

ANTIRRHINUM, the designation of a genus of annual or perennial plants of the natural order *Scrophulariaceæ*, commonly known as snapdragon, on account of the peculiarity of the corolla, the lower lip of

which, if parted from the upper, shuts with a snap. The plants are propagated by seeds sown in gentle heat in spring. They all produce showy flowers and are much cultivated in gardens. Many varieties of some of them, such as the great or common snapdragon (*A. majus*), have been produced by gardeners. The plant is not native in America, such specimens as are seen growing wild having escaped from gardens.

ANTI-SALOON LEAGUE. See PROHIBITION.

ANTISANA, än'tę-sä'na, a volcano in the Andes of Ecuador, 35 miles southeast-by-east of Quito. Whymper, who ascended it in 1880, makes its height 19,260 feet. Tambo de Antisana, one of the highest settlements in the world, is on a slope of this mountain at an elevation of 13,000 feet.

ANTISCIAN (Greek *anti,* over against; *skia,* a shadow), a name applied to those who live under the same meridian, at the same distance north and south of the equator, and whose shadows at noon consequently are thrown in contrary directions.

ANTISCORBUTICS. See SCURVY.

ANTI-SEMITISM. See JEWS — ANTI-SEMITISM.

ANTISEPTIC, any substance which retards or prevents the growth and development of lower forms of organisms injurious to higher forms of life. The discovery that the breaking down or decay of organic bodies was caused by minute plants, fungi, bacteria, etc., led to the idea of preventing the action of these bodies by the employment of some antagonistic substances. In medicine it had been found that many of these bacteria produced a condition known as *sepsis,* or poisoning, and when Sir Joseph Lister first used the carbolic spray to prevent the development of these bacteria the word *antiseptic* came to be applied to any substance that inhibits the growth or destroys bacterial agents of putrefaction. A *germicide* is any agent that kills these low forms of plant life; *fungicides* are used on the large fungi; *bactericides* on the bacteria. The word *disinfectant* properly applies to a substance used for the destruction of a definite infecting agent, such as exists in phthisical sputum, or in typhoid urine or stools, but it too often is employed for some remedy that merely destroys a disagreeable odor — a *deodorant.* Thus most so-called disinfectants, manufactured to place in closets or urinals, are really nothing but strong-smelling deodorants. As disinfectants they are wholly useless. Germicides, bactericides and septicides may be divided into two groups, physical and chemical. In the former group is heat, the most important of all germicides. Burning is the best means for the disinfection of the non-valuable surroundings of patients who have had any severe contagious disease such as diphtheria, typhoid fever, plague, scarlet fever, etc. It is the best agent for the destruction of all tuberculous sputum. Boiling is another efficient means of disinfecting or sterilizing. The boiling of water or milk suspected to contain the bacteria of typhoid or diphtheria is effective. Boiling all bed linen which has been in contact with contagious diseases is advisable.

The boiling of preserves and the airtight sealing of the jars immediately afterward to prevent the entrance of the germs of molds and similar growths is practised by all housewives. When after this the preserved fruit "ferments," it has either not been boiled long enough, the jars were not thoroughly cleansed by boiling water, the rubbers and tops not sterilized or a hole has been left whereby the spores of molds have entered. Cold is a preservative only: it prevents the multiplication of these low forms of plant life, but does not destroy them. The conditions which favor putrefaction are: a moist atmosphere, warmth and the presence of micro-organisms.

Chemical antiseptics have been in use ever since the work of Tyndall, Pasteur, Koch and Lister showed the activity of lower plant forms in putrefaction and sepsis. In the arts many antiseptics are used to preserve foods. The smoking of hams and other meats is the old empirical method, antedating modern means probably by hundreds of years, the smoke containing creosote and bodies related to carbolic acid. Vinegar and spices have been long in use to preserve pickles. Sulphurous acid, alum, salicylic acid, formalin, nitre, common salt, sugar, etc., are all extensively used as food preservatives, but the four first named are considered injurious to health and are forbidden in many States. Other uses of antiseptics in the arts are: the preservation of wood from decay by impregnation with creosote and related fungicides, the preservation of pastes and mucilage with carbolic or salicylic acid, the preservation of sizes used in paper making by sulphurous acid and the use of sodium bisulphate or chloride of lime in sterilizing drinking water. Sodium hypochlorite is used to sterilize swimming pools, and chlorine peroxide for polluted waters. Benzoate of soda is used to preserve prepared foods and permitted by the authorities in limited quantities. Cinnamic acid is used to impregnate the wrappers in which butter is packed. In modern surgery it is not the destruction of bacteria, but rather their prevention, that is desired, and *asepsis,* or the prevention of infection, is the modern method, not *antisepsis.* By thorough sterilization of everything that comes in contact with a patient's body the modern surgeon prevents infection by keeping bacteria out. His instruments are sterilized by boiling in water, by steam or a high degree of dry heat, by washing in chemical antiseptics or by exposing them to formaldehyde vapor. Should the nature of a wound be such that it is already infected, then antiseptics are of service. The most valuable surgical antiseptics are the phenols and their derivatives (carbolic acid, salicylates, etc.), salts of mercury, silver lead, aluminum, copper, and zinc, preparations of chlorine, iodine, bromine, permanganate of potash, benzoic acid, organic aldehydes, formaldehyde, benzaldehyde, alcohol, thymol, menthol, eucalyptol and hydrogen peroxide. Such trade names as Dioxogen, Hydrozone, Glycozone, Pyrozone, and Peroxols, are given to mixtures of hydrogen peroxide with various other disinfectants. See BACTERIA; FUNGI; INFECTION; KOCH; PASTEUR; SPONTANEOUS GENERATION.

ANTI-SLAVERY SOCIETY, The American, was organized in Philadelphia,

December 1833, by delegates from similar local and State societies. The first of these societies was formed in Boston in January 1832 by William Lloyd Garrison and others. The American society took a radical stand for the abolition of slavery. The difference of opinion among the members caused a split in the society in 1840, and eventually both factions joined the Liberal Party. A small coterie of the original society continued to exist however until the adoption of the 15th Amendment in 1870. See LIBERAL PARTY; SLAVERY.

ANTISPASMODIC, a medicine proper for the cure of spasms and convulsions. In general any drug that has a sedative effect upon the nervous system, either by depressing the brain or spinal cord or by stimulating inhibitory centres, and as regulating the production of nerve force. In the former class are the bromides and chloral. The stimulating antispasmodics are asafetida, belladonna, camphor, musk, and valerian. Opium, balsam of Peru and the essential oils of many vegetables are also among the most useful of this class of medicines. Antispasmodics are employed in cases of nervous excitation, particularly of a hysterical nature, in asthma, alcoholism and in convulsions from epilepsy or other causes.

ANTIS'THENES OF ATHENS, a Greek philosopher who founded the sect of Cynic philosophers: b. Athens 444 B.C. He was a disciple of Socrates, and is said to have aided in bringing some of his persecutors to justice. He taught at the Cynosarges, a gymnasium appropriated to Athenians who had foreign mothers. His philosophy was a one-sided development of the Socratic method. According to his teaching virtue should render man independent of the ordinary events of life. He himself lived in a very austere, self-denying fashion.

ANTIS'TROPHE (Gr. *anti*+*strŏphē*, from *strephŏ*, I turn), the name of one of the divisions of a Greek choral ode, corresponding to the *strŏphē* and following it. The singing of the strophes on the stage was accompanied with a motion or turn from right to left.

ANTITORPEDO BOATS. The ideal antitorpedo boat is the destroyer. It is big enough to stay at sea in all weathers. In the United States navy it carries an armament of several four-inch guns and with its speed of from 30 to 35 knots an hour it can swiftly dash down upon torpedo-boats — or submarines — and effectively dispose of them. An essential part of antitorpedo boat defense is *decent realization.* The conditions of attack are such that each defense unit must act on its own initiative, and for torpedo craft the best unit is the single gun. For administrative purposes the unit may be a group of two or three guns, and the gun group commander would have the same duties and responsibilities as a battery commander of medium guns; but for tactical purposes the gun is the best unit, and the gun captain or gun group commander, if single gun groups are employed, must act on his own initiative. The passing of orders, once an action has commenced, would be almost impossible except to each gun separately. Constant readiness for action at night and in thick weather is necessary. Consequently the detachments must be divided into watches, enough men must be kept closely to the guns ready to man them at a moment's notice, and a look-out sentry must be posted at each gun, which must be kept loaded, with an ample supply of ammunition ready to hand on the gun floor. The duties of the sentry are to keep a sharp look-out seaward, and to open fire, without waiting for orders, on any torpedo craft moving at night; only if the gun group commander were actually present on the gun floor would he take his orders before firing. In case of the alarm being given by means of the alarm gong before a target has been sighted, the sentry would pass on the alarm to the detachment. As night attacks are the principal danger, the effectiveness of the antitorpedo boat armament depends on the relative position of the electric lights and guns; and, if fighting lights are used, on their speedy manipulation in accordance with the wishes of those in command of the guns. These conditions absolutely dictate elaborate and expensive preparations in advance; and are quite incompatible with change of position. See SUBMARINES; TORPEDO BOATS; TORPEDOES.

ANTITOXINS, the name given to peculiar bodies developed in the human body or in the body of an animal, supposed to be antagonistic to the poisons, or toxins, of disease. These antitoxins are specific for definite diseases and constitute one of the protective agents in the body's battle with disease. For the full consideration of these and other similar bodies see IMMUNITY; TOXINS and ANTITOXINS.

ANTITRADE, a name given to any of the upper tropical winds which move northward or southward in the same manner as the trade-winds which blow beneath them in the opposite direction. These great aërial currents, descending to the surface after having passed the limits of the trade-winds, form the southwest or west-southwest winds of the north temperate and the northwest or west-northwest winds of the south temperate zones.

ANTITRINITARIAN, a name applied to one who does not receive the doctrine of the divine Trinity as it is represented by the Nicene and Athanasian creeds, and either puts the Son and the Holy Spirit in the Godhead below the Father, or considers Christ as merely a man, and the Holy Spirit an arbitrary personification of the divine mind. Antitrinitarians of the latter class are Unitarians (q.v.), while those of the former class are relatively Trinitarians.

ANTITRUST LAWS, in the United States. The first of these on the statute books was an ordinance of Alabama in 1883 against the pooling of freights by railroads. The first general law against business combinations was enacted by Kansas in 1889. But the general movement against trusts which took shape in legislation was in 1889, when five States and Territories passed laws to render combinations in restraint of trade illegal and punishable, and two more (Washington and North Dakota) incorporated similar provisions into the constitutions with which they were admitted to the Union. In the first half of 1890 three more States joined the movement with legislation; and on 2 July the Federal Congress enacted the «Sherman Law» against trusts. Nearly all the States have since placed like statutes on their books. The provisions are substantially

alike in all, making the persons engaged in such combinations liable to fine and imprisonment, and the corporations or firms punishable by loss of charter or of right to carry on business within the State where the offense is committed. The decisions of the Circuit Courts at first were so narrowed as practically to nullify the provisions of the laws; it being held that the combinations, as at common law, must be proved inequitable and injurious to the public, and calculated not merely to abate competition, but absolutely to monopolize the business for the purpose of extortion. But these decisions were reversed by the United States Supreme Court, which held that the laws made no distinction between partial and complete monopoly, or equitable and inequitable. It had been claimed also that the laws were unconstitutional, as violating the 5th and 14th Amendments, that no person shall be deprived of liberty without due process of law, and that the liberty of making contracts is an essential portion of this; but the Supreme Court interprets them to mean legal contracts, and that under its power to regulate commerce Congress can decide what contracts are legal; while the State courts hold such regulation is competent to the States under their police power.

The Sherman Act is as follows:

1. Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations is hereby declared to be illegal. Every person who shall make any such contract or engage in any such combination or conspiracy shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by a fine not exceeding $5,000, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

2. Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons to monopolize any part of the trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by fine not exceeding $5,000, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

3. Every contract, combination in the form of trust or otherwise, or conspiracy in restraint of trade or commerce in any Territory of the United States or of the District of Columbia, or in restraint of trade or commerce between any such Territory and another, or between any such Territory or Territories and any State or States or the District of Columbia, or with foreign nations, or between the District of Columbia and any State or States or foreign nations, is hereby declared illegal. Every person who shall make any such contract or engage in any such combination or conspiracy shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by fine not exceeding $5,000, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

4. The several circuit courts of the United States are hereby invested with jurisdiction to prevent and restrain violations of this act, and it shall be the duty of the several district attorneys of the United States in their respective districts, under the direction of the attorney-general, to institute proceedings in equity to prevent and restrain such violations. Such proceedings may be by way of petition setting forth the case and praying that such violation shall be enjoined or otherwise prohibited. When the parties complained of shall have been duly notified of such petition the court shall proceed, as soon as may be, to the hearing and determination of the case; and pending such petition, and before final decree, the court may at any time make such temporary restraining order or prohibition as shall be deemed just in the premises.

5. Whenever it shall appear to the court before which any proceedings under section four of this act may be pending, that the ends of justice require that other parties should be brought before the court, the court may cause them to be summoned, whether they reside in the district in which the court is held or not; and subpœnas to that end may be served in any district by the marshal thereof.

6. Any property owned under any contract or by any combination, or purchased to any conspiracy (and being the subject thereof) mentioned in section one of this act, and being in the course of transportation from one State to another, or to a foreign country, shall be forfeited to the United States, and may be seized and condemned by like proceedings as those provided by law for the forfeiture, seizure, and condemnation of property imported into the United States contrary to law.

7. Any person who shall be injured in his business or property by any person or corporation by reason of anything forbidden or declared to be unlawful by this act, may sue therefor in any circuit court of the United States in the district in which the defendant resides or is found, without respect to the amount in conspiracy, and shall recover threefold the damages by him sustained, and the cost of suit, including a reasonable attorney's fee.

8. That the word «person» or «persons,» wherever used in this act, shall be deemed to include corporations and associations existing under or authorized by the laws of either the United States, the laws of any of the Territories, the laws of any State, or the laws of any foreign country.

In February 1913 New Jersey attracted considerable attention by the passage of a bill known as «the Seven Sisters Acts,» which were supposed to represent the personal views of President Wilson on the trust problem. These acts defined a trust as an agreement between corporations, firms or persons for the creation of trade restrictions or the acquisition of monopoly, for the limitation of production or for the raising of prices. They fix the personal responsibility of directors, officers or agents and they forbid differences in prices in different sections, allowance being made for quality, cost of freight, etc., when such differences have the obvious purpose of creating a monopoly or killing competition. They also forbid the holding of stock of other corporations, except for payment of debts, for temporary investment of surplus funds in corporations in other lines of business, for the investment of benefit or insurance funds or for depreciation or rebuilding purposes. Rights

previously acquired, however, are exempt. Future mergers must be approved by the board of public utility commissioners and filed with the secretary of the State.

In January 1914 four bills were introduced into Congress by Representative Clayton of the House Judiciary Committee. These defined illegal acts; the granting of relief to persons injured by the operations of trusts; checking the interlocking of boards of directors and the creation of an Interstate Trade Commission. After much discussion and compromising the final result was the passage, 15 Oct. 1914, of the Clayton Anti-Trust Act, designed as a supplement to the Sherman Anti-Trust Act in its more explicit definitions of illegal acts. It also forbids any corporation or firm from selling its commodities at different prices to its different customers if such action tends to create a monopoly or lessen competition. Numerous exceptions are made, however. Another provision forbids a manufacturer to sell his goods to a dealer on the understanding that he will not buy goods of the same nature from a competitor. Decrees in government trust suits shall be sufficient evidence for private suits for damages under the anti-trust laws. Furthermore, in the case of private suits the statute of limitations shall begin to run only from the date that a decree is entered in a government suit. Holding companies are prohibited in that one corporation may not own stock in another where the effect is "to substantially lessen competition" or to tend to create a monopoly. Another section makes it illegal for one person to be an officer in more than one bank, or of two or more corporations engaged in the same line of business. Moreover, common carriers may not deal with corporations having, in common, directors or officers with themselves, except by competitive bidding.

Included in the "Clayton Anti-Trust Act" is the Trade Commission Act, which provides for the formation of the Federal Trade Commission, to consist of five members appointed by the President and the Senate for terms of seven years, not more than three to be of the same political party. This body was to take over the bureau of corporations and continue its investigations. What constitutes "unfair methods" of competition, when not specifically defined by the other provisions of the Act, is to be left to the judgment of the commission, which is a power similar to that given the Interstate Commerce Commission, in the matter of railroad rates. The commission may order hearings and may enforce its commands through the Circuit Court of Appeals. This court is given exclusive jurisdiction and power of review over this law, but not in regard to facts with respect to orders of the commission. The commission has, in fact, almost unlimited powers in pursuing its investigations. On 13 July 1915, the commission had been organized and established, the President's nominees being Joseph E. Davies of Wisconsin; Edward N. Hurley, Illinois; William J. Harris, Georgia; William H. Parry, Washington; George Rublee, New Hampshire. All except the last two were confirmed by the Senate, the objections being raised on account of political activities. Mr. Rublee, however, was given a recess appointment when Congress adjourned. Consult Walker, F., 'Causes of Trusts and Some Remedies' in *American Economic Association Quarterly* (1910); Giddings, F. H., 'Democracy and Empire' (1900).

ANTITYPE, a word denoting a type or figure corresponding to some other type. It is in the sense of copy or likeness that the word occurs in the New Testament (Heb. ix, 24: 1 Peter iii, 21). By the father of the Greek Church antitype is employed as a designation of the bread and wine in the sacrament of the Lord's supper.

ANTIUM, ăn'shĭ-ŭm, one of the most ancient and powerful cities of Latium, the chief city of the Volsci. It was situated on a promontory, and was a flourishing seaport. It was taken by the Romans in 468 B.C., but soon revolted, and maintained its independence till finally taken by Rome in 338 B.C., and after this it appears as one of the maritime colonies of Rome. Toward the close of the republic and during the empire it was a favorite residence of the wealthy Romans, and both the town and its neighborhood were adorned with temples and splendid villas. Nero and Caligula were born at Antium. It was entirely destroyed by the Saracens; but vestiges of it still remain at Porto d'Anzo, its modern successor, near which many works of art, including the Apollo Belvidere and the Borghese Gladiator, have been found.

ANTIWAR DEMOCRATS, or **PEACE DEMOCRATS,** the Democrats in the North who were in sympathy with the Confederates during the Civil War. They opposed the draft and hindered recruiting, denounced Lincoln and predicted the failure of the war. In the heated controversies of the day they were nicknamed "Butternuts" and "Copperheads." There were among them secret political organizations such as the "Sons of Liberty," "Knights of the Golden Circle," etc. See DEMOCRATIC PARTY.

ANTLERS, the weapons borne upon the head of a male deer during the breeding season. They are an outgrowth of true bone supported upon protuberances from the crown of the skull, called pedicels. As the spring approaches, the hairy skin with which these are covered becomes highly vascular and swollen with blood and serum carrying lime salts. This grows outward and gradually assumes the form of the antler, characteristic of the species, which for a time is in a soft and vascular state, and covered with what hunters call "velvet." There is continually deposited within this growth the substance of bone, which fills and solidifies the structure from the centre outward, until in the course of four or five months all has become solid, the outer skin shrinks and dries and presently falls or is rubbed off. These antlers remain firm upon the head and useful as weapons until the middle of the following winter, when they become loosened and fall off. The process is repeated the following spring, and the antlers are thus lost and replaced annually as long as the stag lives. In the deer, with the single exception of the reindeer, antlers are worn only by the males and are a secondary sexual character. That they are associated with the reproductive function, says Beddard, is shown by their being shed after the period of rut; and also by the stunting effect upon the horns which any injury to the

reproductive glands produces. Various degrees of degeneration are to be seen in the antlers of captive deer resulting from varying degrees and periods of gelding.

The sport of stag-hunting has preserved a set of ancient terms, mostly of French origin in the Middle Ages, designating the different parts of the antler and the successive stages of growth, and these have come to stand for a deer of a certain age or condition. They were all derived from and particularly applicable to the European red deer (*Cervus elephas*), which more than any other species is preserved for hunting in Europe. The nomenclature is summarized as follows in 'Cassell's Natural History,' Vol. III: "In the common red deer, in the spring of the year following its birth, the antlers are nothing more than straight, conical and unbranched 'beams,' the animal being then known as a 'brooket.' In the following spring the antler has, besides the 'beam,' a small branch from its base, directed forward, known as the 'brow antler'; it is then termed 'spayad.' In the third year an extra front branch is formed, known as the 'tres,' and the whole antler is larger. The tres is sometimes seen in the smaller antler of the spayad. In the fourth year the brow antler is doubled to form the 'brow' and the 'bez-tine,' at the same time that the top of the main beam divides into the 'sur-royals' of the 'staggard,' or four-year-old male. In the fifth year the sur-royals become more numerous, the whole antler of the 'stag' being heavier than previously, only to be exceeded in weight by those of the fully adult 'great hart' with 10 or more 'points,' each being larger and longer than the year before." A deer of 12 points is known in Scotland as a "royal stag," but although sometimes antlers have more than 12 points, no recent antlers quite equal those which have been preserved from old times before all the best deer were so systematically shot each year. Where the number of points is exceedingly large, as it is in some curious specimens which show 50 or 75, they are no longer a record of the years of the animal's life, but of injuries to the horns, causing unnatural branchings. The horn of antlers is of commercial value, being much used for the handles of knives and similar articles.

ANTLIA, or **ANTLIA PNEUMATICA,** the name of one of the 14 southern constellations placed in the heavens by Lacaille in connection with his work at the Cape of Good Hope in 1751–52. It is situated between Vela, Pyxis, Hydra and Centaurus.

ANTLION, a term applied to the larva of *Myrmeleon,* a neuropterous insect of the family *Myrmeleonidæ.* It is a singular-looking creature, the body somewhat broad and flattened behind, the head provided with enormous jaws which have a groove beneath, in which the maxillæ slide back and forth. It can thus pierce the bodies of small soft-bodied insects, flies, etc., and suck their blood without moving the jaws on which the victim is impaled. It makes a pit in fine sand, at the bottom of which it lies with its body buried and its jaws wide open, ready to seize any luckless insect which may fall in. When an insect comes near the edge of the pit, the antlion, by a toss of its head, hurls at it a shower of sand, which knocks it down, so that it slides into the pit and is seized. Antlions are known in confinement to spend the winter in the larval state if fed with flies, caterpillars and spiders. In the spring the larva spins a rather large, round, silken cocoon covered with grains of sand, within which it changes to a pupa, and the winged insect emerges early in June. The imago has long, gauzy wings, both pairs alike, and is rarely seen in the Northern States. The conical, crater-like pits of the antlion may be seen in sheltered places in loose sand to the number of from 50 to 75.

ANTOFAGASTA, än'tō-fą-gäs'tą, Chile, a northern province which extends the whole width of the country and bounded on the north by the province of Tarapacá and on the south by the province of Atacama. Area, 46,609 square miles. It was ceded by Bolivia to Chile after the War on the Pacific. The systematic development, during the last 30 years, of its nitrate industry, and the exploitation of other mineral resources of this region, have greatly increased the revenues of the nation. Population about 120,000. For the War on the Pacific, or "War of the Pacific," climate, irrigated valleys, etc., see CHILE.

ANTOFAGASTA, Chile, capital of the province of the same name; port through which large quantities of nitrate are shipped; terminus of one of the railways connecting cities of the Andean highlands in Bolivia with the Pacific coast. It ranks, among Chilean ports, as second in the value of materials exported and as third in the value of merchandise imported. The number of inhabitants (including, with the city, some of the adjacent regions) is about 65,000. For climate, etc., see CHILE.

ANTOKOLSKII, Mark Matvyeevich, Russian sculptor: b. Vilna 1842. He received his elementary education and his first notions of sculptural art in an engraving factory in Vilna. In 1863 he entered the Academy of Fine Arts and within two years received a prize for his wood carving 'Evening Toil of an Old Jew' and another for the carving in ivory, 'The Parsimonious Jew.' As early as 1865 he attracted general attention and the Emperor sent him abroad at his own expense to continue his studies. In 1871 appeared his remarkable work, 'Ivan the Terrible,' which induced the Academy to elect him a permanent member. By order of Alexander II the statue was founded in bronze and a plaster molding of it was sent to the Kensington Museum in London. At that time Antokolskii made the sketches 'The Controversy about the Talmud' and the 'Attack of the Inquisition on the Jews'; in 1872 the colossal statue of 'Peter I,' also the historic figures of 'Yaroslav the Wise,' 'Dimitrius of the Don' and 'Ivan III.' Three years later his 'Christ before the People' was accepted by Alexander II and a marble copy of it was sent to the Paris Exposition of 1878. His other works executed at that time ('Death of Socrates,' 'The Last Breath,' 'The Head of John the Baptist,' etc.) established his fame and the French Academy bestowed on him the cross of the Légion d'Honneur. In 1880 the Academy of Arts in St. Petersburg organized a general exposition of his works (sculptures and sketches) and bestowed on him title of professor of sculp-

ture. Soon afterward he went to Paris where he produced 'Spinosa,' 'Nestor,' 'Not of the World' and a great number of bust-portraits of notable personalities in France and Russia. Antokolskii's work represents an epoch in the Russian history of sculpture by its originality and individuality; he refrained from imitating the ancients whose aim was beauty of form, but adopted and observed as his key-note beauty of thought and conception. He has lived to the height of his task and has succeeded to a high degree in supplanting the beauty of form by beauty of thought.

ANTOMMARCHI, än'tōm-mär'kę, **Carlo Francesco,** Italian physician: b. Corsica, 1780; d. Saint Antonio, Cuba, 3 April 1838. He was professor of anatomy at Florence when he offered himself as physician of Napoleon at Saint Helena. Napoleon as first received him with reserve, but soon admitted him to his confidence, and testified his satisfaction with him by leaving him a legacy of 100,000 francs. On his return to Europe he published the 'Derniers Moments de Napoléon' (1823). He also wrote the text for a folio series of anatomical plates published in 1823–26, and in 1830 exhibited what he asserted to be a death mask of Napoleon. In 1836 he went to New Orleans, where he practised homœopathy.

ANTONELLI, än'tō-nĕl'le, **Giacomo, Cardinal,** Italian ecclesiastic: b. 1806; d. 1876. He was educated at the Grand Seminary of Rome, where he attracted the attention of Pope Gregory XVI, who appointed him to several important offices, and on the accession of Pius IX, in 1846, Antonelli was raised to the dignity of cardinal-deacon. Two years later he became President and Minister of Foreign Affairs, and in 1850 was appointed Secretary of State. During the sitting of the Œcumenical Council (1869–70) he was a prominent champion of the papal interest. He strongly opposed the assumption of the united Italian crown by Victor Emmanuel.

ANTONELLO DA MESSINA, Sicilian painter: b. Messina about 1430; d. 15 Feb. 1479. But few artists of Antonello's importance have left such slight clews for the biographer, and it is only in recent years that the diligent investigations of archæologists have brought to light a certain amount of sure material as to the painter and dispelled the errors previously believed. We now know from contemporary documents that he was the son of Giovanni, a sculptor, whose family name was D'Antonio. The painter's history is covered by the few dates we have concerning him. In 1457 he received a commission for a banner for a church at Reggio, Sicily. In 1460 he was in Calabria and in the next years at Messina again. In 1475 he was at Venice, where in March 1476 "he received an invitation to enter the service of Galeazzo Maria Sforza, Duke of Milan. Antonello accepted the invitation; but by the following month of September he was back at Messina." He continued to live there until his death. Vasari's well-known story that Antonello journeyed to Flanders and learned the secret of oil painting from Jan van Eyck by introducing himself in disguise into the studio of that painter has been doubted in recent years because Vasari's account of the great Sicilian is inaccurate in many respects. Yet certain facts remain which keep open the possibility that our best guide in the history of old Italians may prove to be right again. One of these facts is that Antonello had mastered the technique of oils at a time when no countryman of his knew how to employ them, whereas the Flemings were already proficient in their use. Besides, there are evidences in Antonello's work that he knew Flemish architecture, and if it be allowed that he could have learned oil-painting from seeing Flemish pictures of which there were numbers in southern Italy, it seems extremely improbable that he could have introduced into his work the representation of places that he had not seen. Two examples in point are the 'Head of a Man' at Bergamo and Mr. H. C. Frick's 'Deposition from the Cross' in New York. Again the old claim that he taught oil-painting to the Venetians may easily be substantiated yet, if it is discovered that he was in Venice prior to the journey of 1475 which is the only one of which we have a sure record. We know of no Venetian painting in oil previous to 1473, and we are certain that Antonello's stay in Venetia had a marked influence on the northern painters. The discovery of oils certainly changed Venetian painting most radically. Leaving aside historical considerations which are too apt to absorb attention when writing of Antonello, we see him as one of the very great artists of the Renaissance. The Flemish precision which was the staff on which he leaned in early years was quickly transmuted by him into a greater thing — his Italian feeling for the rhythm of line giving a new meaning to the draughtsmanship he inherited. We have but to consult the 'Saint Jerome' of the National Gallery, London, or the 'Saint Sebastian' in Dresden to confirm this idea. To find his peers in the handling a contour one must go to the supreme men, like Leonardo. His startling insight into the psychology of his portrait-sitters is to be observed in such works as the 'Condottiere' of the Louvre or the 'Portrait of a Man' at the Borghese Gallery in Rome. One feels the tremendous originality of the artist before a composition like the 'Crucifixion' of the Antwerp Gallery, supported by his impeccable mastery of form and his beautiful color. Other important works by him are the 'Salvator Mundi,' probably an early picture, in the National Gallery, London, which also possesses a 'Portrait of a Man'; the 'Dead Christ' at the Vienna Museum, and the very fine 'Man's Portrait' in the Berlin Museum. The last named is considered by many the best example of his work. Antonello was the only great painter of the Renaissance in south Italy. His reputation was as great among his contemporaries as in modern times. Consult the monographs by Di Marzo (Palermo 1903), and D'Amico (Messina 1904), and L. Venturi, 'Le origine della pittura veneziana' (Venice 1907).

ANTONINE COLUMN, the name given to the sculptured pillar erected by Marcus Aurelius to the memory of his father-in-law, Antoninus Pius. The splendid staircase, with 190 steps hewn in the 19 blocks of marble of which the column is composed — the statue of Saint Paul crowning its top — and the basreliefs around the column illustrating the victories of Marcus Aurelius over the Marcomans, present an appearance of singular magnificence.

The Doric and Corinthian styles are blended in the architecture of the column in a remarkable manner. The pedestal and top are Doric, while the proportions of the column are Corinthian. The bas-reliefs, in imitation of those of the column of Trajan, are in beauty and purity of execution rather inferior to the original. The column was restored to its present condition in the latter part of the 16th century by Domenico Fontana, the architect of Sixtus V, and still stands in the Piazza Colonna as one of the chief ornaments of Rome.

ANTONINUS, Marcus Aurelius. See AURELIUS ANTONINUS, MARCUS.

ANTONIUS, Gaius, Roman consul, the colleague of Cicero, who defended him when accused of participation in the Catiline conspiracy. He was the son of Marcus Antonius the orator, and an uncle of Mark Antony.

ANTONIUS, Marcus, famous Roman lawyer surnamed the Orator: b. 143 B.C.; d. 87 B.C He was prætor in 104, when he fought against the pirates of Cilicia; consul in 99, when he distinguished himself by his resistance to the party of Saturninus; and censor in 97. He was famed for his eloquence in the forum, rendering, according to Cicero, Italy the rival of Greece, and for his integrity in public life. As an aristocrat he adopted the party of Sylla, and was put to death by Marius and Cinna, when they triumphed. He was one of the interlocutors in Cicero's 'De Oratore.'

ANTONIUS, Marcus, commonly known as Mark Antony, a Roman triumvir: b. 86 B.C.; d. 30 B.C. He was the grandson of Marcus Antonius, the greatest orator and one of the greatest men of his day. His father, also Marcus Antonius, was surnamed Creticus in derision, from a disgraceful defeat which he suffered in an unprovoked invasion of the isle of Crete. He went abroad early, served with Gabinius in Syria, and distinguished himself greatly, both there and in Egypt, where he already gave tokens of consummate soldiership. He next joined Cæsar in Gaul, where he passed several campaigns with increasing honor as one of his legates, and deserved much of the credit, usually given to his leader, for the total defeat of Vercingetorix at the terrible siege of Alesia. Being elected one of the tribunes of the people, when the Senate ordered Cæsar to disband his forces, he, with Quintus Cassius, vetoed the bill; and, on the Senate proceeding to arm the consuls with dictatorial power by the vote *ne quid respublica detrimenti capiat,* they fled together, disguised as slaves, to Cæsar's camp, feigning to believe that their lives were in danger, thus giving that ambitious general the desired occasion for crossing the Rubicon and marching upon Rome. In reward for this service, when Cæsar went to follow up his fortunes by crushing out the Pompeian party in Spain, he left Antony governor of Italy and lieutenant-general of his forces. He astounded all Italy by the ostentation and cynicism of his vices, but when the last struggle took place between Pompey and his own commander, he at once laid aside the debauchee and resumed the soldier. His skill preserved the fleet and intrenchments at Dyrrachium; it was he who commanded the victorious left wing in the crowning conflict at Pharsalia, and turned the wavering tide of success to the standards of Cæsar. When the Ides of March had come, and great Cæsar fell at the base of Pompey's statue, it was the masculine and sonorous eloquence of Antony — for he was an orator second to Cicero and Cæsar only — that did actually raise the stones of Rome to mutiny and forced the discomfited murderers to fly from their half-finished task. It was Antony's soldiership and Antony's sword that defeated Cassius and drove Brutus to suicide, while the cold, cowardly, crafty Octavius was sleeping in his secure tent. In the proscriptions which followed it is characteristic of Antony that he was by so much the more insolent, as he was the less cruel, of the triumvirs. But the third triumvir, the imbecile Lepidus, was soon disposed of, and Octavius and Antony divided the Roman world, as masters. Anthony took the East; Octavius, the cold formalist, betook himself to the West. Thenceforth the life of Antony was one wild dream Once he broke from his luxurious lethargy, invaded central Armenia and penetrated Parthia; and then, forced to retreat at length by the circumstances of the country, the climate, the innumerable hordes of Oriental horse, brought off his army by a most extraordinary retreat. In 21 days he fought 18 pitched battles, marched 300 miles, through one continuous skirmish, and when he reached the boundary stream his Parthian pursuers unstrung their bows and bade him go away unharmed. He returned to his life of luxury and to Cleopatra, but his career was run. Rome took arms against him; his troops, his mistress, his fortune deserted him; and Actium saw him, for the first time, with his back to his foes. Deceived to the last by the Egyptian Queen, who imposed upon him by a false rumor of her death, he died by his own hand. Most like he was to Mirabeau in that he was everything at times, and in everything almost the greatest, but nothing long — orator, soldier, statesman; trifler, buffoon; tribune, triumvir, conqueror; faithful lover, false husband, frantic debauchee; and, when the wine of life was quaffed to the lees, a fearless suicide at last.

ANTONY AND CLEOPATRA. On 20 May 1608. Blount entered in the Stationers' Register "A Book called Antony and Cleopatra." This was undoubtedly Shakespeare's 'Antony and Cleopatra.' Internal evidence also places the date of composition at 1607–08, when the dramatist was in the full maturity of his powers. So far as we know, the play was not printed until it appeared in the First Folio of 1623. Shakespeare's single source, "The Life of Marcus Antonius" in North's 'Plutarch,' is followed closely, except for certain omissions which serve to accelerate the dramatic action and to free Antony from unjust charges of voluptuousness and cruelty brought against him by history. While 'Antony and Cleopatra' ranks high among the great tragedies of Shakespeare's third period of dramatic activity, it is the most faultily constructed of all of them. Certain critics profess to have detected a change of emphasis at the end of the third act, where the purely historical interest of the first part gives way to the psychological and personal interest connected with the two principal characters in the second part of the play. But the apparent change of emphasis is unreal; the latter interest is dominant throughout the

play, the historical material of the first part merely furnishing a spectacular background of empire and war for the drawing of protagonists of almost superhuman proportions. A more serious blemish is the confusion resulting from the introduction, particularly in the fourth act, of short, scrappy scenes of battle with constantly changing groups of actors. As in the fourth act of 'King Lear,' the necessity of taking in imagination frequent and fatiguing journeys over thousands of miles is bewildering to the reader's mind and detracts from the impression of unity necessary in a perfectly constructed drama. In spite of differences of opinion, however, 'Antony and Cleopatra' is a pure tragedy, in which the moral purpose of the dramatist predominates over either historical or political considerations. The whole play is a powerful elaboration, in language of unparalleled beauty and imaginative power, of the theme of inevitable destruction visited upon a man of extraordinary possibilities because of voluptuous self-indulgence. Antony, a man of prodigal powers and of heroic but unsymmetrical proportions, is placed in an enervating atmosphere of sensuous splendors; the strong sensual set of his nature responds to the physical fascination of Cleopatra so that he becomes her slave; his imagination is ensnared by her endless variety; and, in spite of vigorous resistance, he finally plunges to destruction. His nobleness of nature takes corruption from his one «vicious mole of nature.» He loses his prodigious energy, forgets the meaning of honor, his judgment becomes impaired and the joy of life is swallowed up in the despair of spent forces, out of which he snatches just strength enough to die bravely. Though Shakespeare denies none of the glory of earthly pomp and the splendor of sensuous passion, still as an artist he is true to the moral law which pronounces the worship of pleasure a deceit and a snare. In Cleopatra, Shakespeare has given us the most complex and wonderful of all his miraculous creations of women. She is the personification of voluptuous attractiveness, whose fascination lies in her power of appeal not merely to the senses but to the sensuous imagination. In spite of her superior mental qualities, her unparalleled grace and beauty, and her vivacity of imagination, we still find in her all that is gross and wanton in womanhood. As Mrs. Jameson says, «Cleopatra is a brilliant antithesis, a compound of contradictions, of all that we most hate, with all that we most admire.» Yet such is the art of Shakespeare that the reader is nowhere brought into sympathetic relationship with her personality. We see the disastrous effects of her witchery and charm upon those about her; we have reported to us the fact of her fascination; but when she appears she is for the most part unattractive, irrational, capricious, cunning and at times even repulsive. While we may admire her spirit on occasion, her moral obliquity never has our sanction; we have neither love for her in life nor pity in death. Though her love is not purified by suffering, as some have maintained, still we cannot help feeling that in the creation of this infinite character Shakespeare has given to life a new and fuller meaning.

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ANT PLANTS. See MYRMECOPHILY.

ANTRAIGUES, än'trāg, Emanuel Delaunay, COMTE D', French politician: b. Villeneuve de Berg, 1755; d. 22 July 1812. His talents first appeared in his 'Mémoires sur les Etats-généraux' (1788), full of daring assertions of liberty, and one of the first sparks of the fire which afterward rose to such height in the French Revolution. When chosen, in 1789, as a deputy, he defended the privileges of the hereditary aristocracy, ranked himself with those who opposed the union of the three estates, and maintained that the royal veto was an indispensable part of good government. After leaving the Assembly in 1790, he was employed in diplomacy at Saint Petersburg and Vienna, where he defended the cause of the Bourbons. In 1803 he was employed under Alexander of Russia in an embassy to Dresden, where he wrote against Bonaparte a brochure entitled 'Fragment du XVIII Livre de Polybe, trouvé sur le Mont Athos.' He afterward came to England and acquired great influence with Canning. He was murdered, with his wife, at his residence near London, by an Italian servant.

ANTRIM, Ireland, county in Ulster Province, bounded on the north by the Atlantic Ocean; east by the North Channel; south by the river Lagan and Lough Neagh and west by the river Bann. Its area is 1,237 square miles (Pop. 193,-864), nearly all of which is under cultivation. There are rich beds of iron ore at Glenravel, and extensive mines of fine salt are being worked at Dunerul and Carrickfergus. The chief occupations of the people are the raising of flax, fishing, and the manufacture of linen, cotton and heavy woolen goods. The capital is Belfast, and other places of note are Larne and Carrickfergus. The town of Antrim, situated at the north end of Lough Neagh, on the Six-Mile Water, is not a place of much consequence, though bleaching and malting and the linen and paper manufacturing are carried on here. There is a very perfect round tower near it.

ANTROBUS, ăn'trō-bŭs, SIR Edmund: b. 1848; d. 11 Feb. 1915; the last hereditary owner of Stonehenge, which was included in the Amesbury Abbey estate. This remarkable pile of monoliths is considered the oldest structure in the British Isles erected by the hand of man. In 1902 Antrobus was the target of severe criticism owing to his decision to erect a fence around the pile and to exclude visitors, a step rendered necessary to protect the historic monument from the vandalistic propensities of excursionists. Stonehenge was sold by auction in September 1915 to Mr. C. H. E. Chubb, of Salisbury, for $33,000.

ANTROPOV, Alexyei Petrovich, än-trō'-pof, a Russian painter, a pupil of A. Matvyeyev,

of the icon painter Vishnyakov and of L. Carravac: b. 14 March 1716; d. 12 June 1795. A prominent "Elizabethan," a master of design and of perspective and in several respects a person of no ordinary calibre, his special and particular merit was that independence of character which prompted the establishment of his own school of painting — a school that counterbalanced the official academy and produced one of the greatest of Russian painters, Levitzky. "The descendants of the latter," writes A. Benois in 'The Russian School of Painting' (New York 1916), "have to this very day preserved memories of Antropov, as of an independent man who held in disdain the official artistic world and warned his young pupils against the pernicious influence of the Academy." He began his quest of an artistic education when only 16 years old, in studios of different Russian and foreign painters, and again, when Rotari came to Russia about the middle of the 18th century, gladly availed himself of the opportunity to assimilate and make his own the firm and lucid manner of that Italian master; for the independence he had asserted and sustained against academic prejudice was not based on obstinacy or complacent self-esteem. It is in the manner perfected under Rotari's influence that Antropov's two best portraits are executed — the portrait in the Tretyakov or Tréliakof Gallery (identity of sitter unknown) and the portrait of the Countess Rumyantzev in the Museum of Alexander III. The latter work, dated 1764, is most characteristic. Incomparably weaker are his portraits of the czars, for the simple reason that Antropov, when painting these, was obliged to have recourse to data supplied by other people. These are not "from life"; and so rather helplessly the artist, unpracticed in this particular form of invention, "heaped up in these portraits all sorts of details" borrowed from Tocqué, Grot and Develis. By Antropov are also various paintings of sacred subjects for the Empress and for many churches (the icons preserved in the Church of Saint Andrew at Kiev being of special interest); a full-length portrait of Czar Peter III, and a portrait of Catharine II in coronation robes.

ANTSMONITE. See STIBNITE.

ANTWERP, Belgium (Dutch, *Antwerpen;* French, *Anvers;* Spanish, *Amberes;* Old German, *Antorff;* from "aent werf," "on the wharf"), the northernmost province, consisting largely of an extensive plain of 1,096 square miles, scarcely diversified by a single elevation. It is sandy but fertile, producing grain, flax, hemp, fruit and tobacco, as well as cattle, sheep and horses; on the north and northeast, however, there are considerable tracts of morass and heath. The principal rivers, the Scheldt and its tributaries, the Rupel, Nèthe and Dyle, are navigable; while railways intersect the country in various directions, and there are also several canals. The chief towns are Antwerp, Mechlin (Malines), Turnhout, Lierre and Boom. Pop. 1,005,000.

ANTWERP, Belgium, capital of the province of the same name, situated about 50 miles from the open sea and 25 miles north of Brussels, in a level tract on the right bank of the Scheldt, which is there about 2,200 feet broad and has a depth at ebb-tide of from 30 to 40 feet, with a rise at spring-tides of 12 or 14.

Since 1905 new docks and granite quays with every modern improvement have greatly added to Antwerp's reputation as one of the finest harbors and one of the busiest commercial ports in the world. The volume of its exports averages annually from 6,500,000 to 8,000,000 tons in recent years, valued at from $360,000,000 to $450,000,000, while the imports average slightly above the same amounts — the largest of the imports being grain. The chief manufacturing industries of Antwerp comprise textiles, brewing, distilling, diamond-cutting, sugar refining, cigars and tobacco. Modern Antwerp is one of the most attractive of improved European cities. It still retains a few of its historical buildings.

The Cathedral of Notre Dame, dating from the 14th century, is its most noteworthy edifice, the largest and most beautiful Gothic structure in the Low Countries, with a tower over 400 feet high. Its area is 70,060 square feet and it contains Rubens' paintings, 'The Descent from the Cross,' 'Elevation of the Cross' and 'The Assumption.' Other important buildings are the church of Saint Jacques, begun in 1491, the Hotel de Ville, the Bourse, the Museum, the old Meat Market, the Archers' Guildhall and the restored Steen, part of the old 10th century castle, now occupied as a museum of antiquities. Fine boulevards mark the sites of ancient city walls and ramparts which were gradually extended and improved until they attained a circuit of over eight miles with a system of eight outlying forts for defenses. After the Franco-German War of 1871–72 this system was strengthened by a second extended line of 15 forts which by 1913 were considered to have made Antwerp one of the strongest fortified cities in the world.

Antwerp is the birthplace of a number of distinguished men in various departments, as the painters Vandyck (b. 1599), Teniers the elder (1582), Teniers the younger (1610), Jordaens (1594), Frans Floris (1520), Gonzales Cocques (1618); the philologist Gruter (1560), the geographer Ortelius (1527), the engraver Edelinck (1649), and, among more modern celebrities, Van Materen the historian, Ogier the dramatist, and Henri Conscience the novelist. Rubens was born at Cologne, but his family belonged to Antwerp, and he was educated, resided and died in the latter city.

Antwerp was probably founded some time before the 8th century, when the Antwerpians or Ganerbians, as they began to be called, were converted to Christianity. In 837 the town fell into the hands of the Northmen, who kept possession of it for about 60 years. It was erected into a marquisate of the Holy Roman Empire by Henry II in 1008, and as such was bestowed by Henry IV, in 1076, on Godfrey of Bouillon. About the beginning of the 12th century it had considerable commercial prosperity; and in the 13th its municipal institutions took definite shape. It is worthy of notice that the law of 1290 contained provisions identical with those of the Habeas Corpus Act of England, maintaining the inviolability of the citizen's dwelling and acknowledging the right of every man to be judged by his peers and to have a voice in the imposition of taxes. As the result of such security and freedom the commerce of the city rapidly increased. English wools for the great manufactories at Louvain,

Brussels, Tirlemont, Diest and Leau were imported through Antwerp; and English merchants, who formed a "factory" there in 1296, received special protection by charters (1305, 1341, 1346, 1349) from the Dukes of Brabant. Between 1488 and 1570 was the time of the greatest prosperity which Antwerp was destined to attain for several centuries. The discovery of America in 1492, and of the passage to India in 1497, produced a great change in all European navigation, permanently altering the old courses of commerce. While in consequence of this the cities of the Hanseatic League had withered, and Venice, Nuremberg and Bruges were sinking into decay, Antwerp was rapidly growing wealthy, but in 1576 it was taken by the Spaniards and given up to a three-days' pillage. It was vainly besieged by the Duke of Alençon in 1583; and after a very obstinate defense it fell before the assaults of the Duke of Parma, whose triumphal entry took place 17 Aug. 1585. Its glory departed; its commerce was ruined; its inhabitants were scattered. The Dutch in their jealousy endeavored to complete its ruin by building forts on the river to intercept the passage of ships; and finally, by the peace of Westphalia in 1648, the Scheldt was definitely closed. In 1794 the city fell into the hands of the French, who opened the river and made Antwerp the capital of the department of Deux Nèthes. It continued in French possession till 1814. Matters of dispute between Belgium and Holland being settled by the treaty of 1839, Antwerp continued peacefully to advance in prosperity until the outbreak of the great European War in 1914, when during the German invasion, the city was subjected to Zeppelin raids and the forts underwent a bombardment of 10 days and were reduced to ruins. The Belgian army with their British allies withdrew and, without any form of surrender, the Germans entered and occupied the city 9 Oct. 1914, subsequently levying oppressive tribute on the inhabitants. Population (exclusive of suburbs) 312,000; with suburbs, 399,000.

ANUCHIN, Dimitri Nikolaievich, ä-noo'-chēn, Russian anthropologist and geographer: b. St. Petersburg, 27 Jan. 1843. Elementary education he received in a gymnasium. Later he studied history and philology at the University of St. Petersburg; specialized in anthropology and zoology at the University of Moscow. In 1880 the University of Moscow awarded him the degree of M.A. for the dissertation 'Concerning Certain Anomalies of the Human Skull.' After a preliminary preparation abroad at the expense of the university, he was appointed assistant professor in anthropology, in 1884 sub-professor in the newly established faculty of geography and anthropology, and in 1887 regular professor. In 1889 the University of Moscow awarded him the honorary degree of doctor of geography. He was the first to introduce the teaching of anthropology, ethnology and agriculture in Russian universities. He originated at the University of Moscow an anthropological museum (1879) and a Museum of Geography (1892). He has been connected with the Society of Amateur-Students of Anthropology, of which he was in succession secretary, associate chairman of the department of anthropology, vice-president and, since 1892, president. At his initiative a department of geography was established at the University of Moscow (1892), which in 1894 started the publication *Zemleviedeniye* (Geography) with Anuchin as editor. After 1875 he took part in the activities of the Imperial Archæological Society of Moscow, of which he was associate chairman for 20 years. He is an honorary member of the Academy of Science of the University of Kazan, of the London Anthropological Institute and of many other scholarly societies. His most valuable works are his popular scientific articles published in *Priroda* (Nature, 1874–75); 'Obschestvo Liubitelei Yestestvovedeni,' (Bulletin of the Society of Amateur-Students of Natural History 1887); 'Western Geographical Society' (1889); 'Drevnosti' (Antiques, ed. by Archæological Society of Moscow 1890); 'Zemleviedieniye' (Geography, 1895); 'Trudui VI Odesskavo Archæologiches Kavo Syezda' (Vol. VI of the Archæological Society of Odessa, 1886); 'Trudui V Tiflicheskavo Archæologiches Kavo Syezda' (Vol. VI of the Archæological Society of Tiflis, 1887); and other scientific publications. A series of his scientific articles is also published in the 'Encyclopædic Dictionary' of Brockhaus and Efson. He also contributed to *Russkaya Viedemosti* whose publisher he has been since 1883 and one of its editors since the nineties.

ANUS, the external termination of the rectum. The external and internal sphincter muscles keep it firmly closed and the levator ani muscle supports the rectum and pelvic structures and lifts up the lower end of the gut during the act of defecation. Infants are sometimes born with a congenital closure of the rectum, consisting usually of a thin skin. The obstruction is removed by a simple surgical operation. Occasionally there are more complicated cases, such as when the gut terminates in a blind sack at a distance from the rectum, or when the rectum terminates in the bladder or vagina. These cases require opening of the abdominal cavity and creating an artificial anus in the lower part of the abdominal wall. The anus is subject to various diseases. Ulceration around or within the anus is a frequent occurrence in persons of uncleanly habits. Attention to cleanliness and treating the ulcers with caustics generally effect a cure. Fissure or cracks in the folds of the skin at the verge of the anus cause great pain during evacuation and are usually treated by a diet tending to procure regular and softer evacuations, and immediately sponging with warm water. Various ointments are also applied to promote healing. Pruritus ani or itching often causes suffering and discomfort and may result from any general disorder of the system. It generally disappears when the cause is removed. Other diseases of the anus are fistula, piles and prolapsus.

ANVIL, an iron or steel block with a smooth top on which malleable metals are hammered and shaped. They vary in size from the small articles used by gold- and silversmiths or jewelers to the huge blocks of power hammers. Blacksmiths' anvils have a cone at one end of the flat face for rounding metals such as horseshoes. Anvils generally are made of cast iron faced with steel.

ANWYL, ăn''l, Sir **Edward,** Welsh: philologist and author: b. 1866; d. Pontypridd, South Wales, 8 Aug. 1914. He was formerly

professor of Welsh and comparative philology at the University College, Wales, was member of many educational bodies and published several books on the Celtic language, literature and religion. He was knighted in 1911 and shortly before his death was appointed principal of the Monmouthshire Training College.

ANZAC, ăn'zăc, Turkey, a name given by the British to a cove at Gaba Tepe, on the Gallipoli peninsula. The word is made up of the initials of the Australian and New Zealand Army Corps, previously assembled at the concentration camps in Egypt, which landed at this spot during the Entente Allies' ill-fated Dardanelles campaign 3 March 1915. It was proposed to alter the name to "Anziac," the addition of the letter "i" being meant to include the Indian Corps which arrived in April, and with a powerful force of troops from southern France, reinforced the Allies in their naval attack on the Dardanelles, the British colonials being assigned to the European side and the French to the Asiatic. The operations were successful at first, and the Allies established themselves firmly around their positions, although the Turks under the guidance of their German officers inflicted severe losses. Almost daily fighting continued until a landing was effected by new troops 6 August at Suvla Bay, 20 miles from the Anzac position, and fresh attacks were made in conjunction. The attack by the Anzac troops, after a series of desperate actions, was carried to the summit of the dominating Sari Bahr and the Chanak Bahr ridges, and although repulsed, positions were consolidated effectively close by. More fighting occurred until the abandonment of the Dardanelles campaign led to the successful withdrawal on 19 December of the colonial troops from the lines which they had so gallantly won and held for over five months at Anzac and Suvla Bay in the rear of the Dardanelles forts. See AUSTRALIA AND THE WAR.

ANZENGRUBER, ăn'tsĕn-groo-bĕr, **Ludwig**, German dramatist: b. Vienna, 29 Nov. 1839; d. Vienna, 10 Dec. 1889. In early life he sometimes wrote under the pseudonym L. Gruber. His father's ancestors were Austrian peasants and his mother was of Viennese descent. The elder Anzengruber, who was an admirer of Schiller, tried his hand at writing dramas and stories but without success. He was instrumental, however, in early turning the attention of his boy to the drama and the theatre. The family lived in straitened circumstances and when the father died young Ludwig had to take a position in a bookstore. The duties of the position did not greatly appeal to him, but he had an opportunity to satisfy his taste for wide reading. His early interest in the theatre developed and in 1859 he became a traveling actor, going about the country accompanied by his mother. On these journeys he had opportunity to become acquainted with various types of characters which he later embodied in his dramas and novels. In fact, these travels brought nearly all the knowledge of peasant life that he possessed, as the rest of his days were spent in Vienna.

In 1869, after having been without a theatrical engagement for some time, he took a position as clerk in the Vienna police department. This experience he always valued, as it made him more intimately acquainted with human nature and gave him a knowledge of the seamy side of life. He wrote popular plays all along but had achieved success with none of them, when suddenly in 1870 he became famous with his 'Pfarrer von Kirchfeld.' The public was visibly affected when it was presented on the stage and its reputation was helped by the favorable criticism of Heinrich Laube. Anzengruber now resigned his position with the police department and devoted all his attention to literary work. Among his dramas of this period 'Der Meineidbauer' (1871), 'Die Kreuzelschreiber' (1872), 'Der G'wissenswurm' (1874), 'Der Doppelselbstmord' (1875), 'Der ledige Hof' (1877), 'Das vierte Gebot' (1877) are the most important. In 1878 he was awarded the Schiller prize.

Then followed a period of unproductivity in the drama due largely to the failure of two of his plays in 1879. The years 1880–84 were mostly devoted to the writing of novels and short stories and the editing of a journal, *Die Heimat*. In 1885 he secured a fixed income as editor of the humorous paper *Figaro*. Beginning with 1886 the interest in his dramas was again revived in Vienna. In the meantime he had made his reputation in north Germany. 'Das vierte Gebot' had been especially well received in Berlin. In 1886 he was awarded the Grillparzer prize for his drama 'Heimg'funden' (1885). Of his later dramas 'Stahl und Stein' (1886) and 'Fleck auf der Ehr' (1889) should be mentioned. At this time the Vienna theatres were again producing his plays with continued success. When Anzengruber died in 1889 he was the leading dramatist of the German-speaking people of that day.

He also wrote novels of interest and power, the chief ones being 'Der Schandfleck' (1876, rewritten 1883) and 'Der Sternsteinhof' (1885), and a number of excellent short stories. But his great importance as a writer is in his dramas. He was a reformer of the German stage. He put his plays upon a popular basis. His characters are largely original and selected from among the people, many of them using the dialect of the Austrian peasantry. He depicted life in a realistic manner as he himself saw it and had experienced it. The popular farce, as it existed on the Vienna stage at that time, he developed into a dignified drama of psychological depth. The scenic effect of his plays was heightened by making use of music. He was imbued with optimism and a genuine humor emanates from his characters. Withal he was serious of purpose and didactic, at times extremely so, some of his characters having a tendency to preach and to exhort. (See PRIEST OF KIRCHFELD, THE.) Consult Gesammelte Werke (10 vols., 1890; 3d ed., 1897); Bettelheim, A., 'Ludwig Anzengruber, der Mann, sein Werk, und seine Weltanschauung' (in 'Geisteshelden,' Vol. IV, 2d ed., Berlin 1898); Friedmann, S., 'Ludwig Anzengruber' (Leipzig 1902).

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AORIST (Greek, *aoristos*, "indefinite"), the name given to one of the tenses of the Greek verb, expressive of indefinite past time. The Greek verb is very rich in past tenses,

possessing besides the aorist the imperfect, perfect and pluperfect. While these express repetition, continuance or the relation between one time and another, no such shade of meaning attaches to the aorist. The difference between the first and the second aorist is in form only and not in meaning.

AORTA, the name given to the great arterial trunk of the body. It springs from the left ventricle of the heart, arches backward to the vertebral column, and, descending in the back portion of the thorax, passes through the diaphragm into the posterior part of the abdomen, at the lower portion of which, opposite the fourth lumbar segment of the spinal column, it divides into the two common iliac arteries. Throughout its course it becomes smaller and smaller, and gives off a large number of branches that send blood to all parts of the body. It is not divided into any distinct divisions, but for conventional purposes of description anatomists describe three parts, the arch, the thoracic aorta and the abdominal aorta. The arch reaches to the lower border of the fifth thoracic vertebra; from this point to the opening in the diaphragm it is known as the thoracic aorta; from the diaphragm to its bifurcation into the iliacs, the abdominal aorta. At its very beginning at the top of the heart it gives off the coronary arteries that supply the walls of the heart with blood. The arch is then conventionally divided into three parts, the ascending, transverse and descending portions. From the transverse portion of the arch the great vessels of the neck, head and arms are given off,—the innominate or brachiocephalic artery, that goes to the head and upper extremity of the right side, the left common carotid, to the head on the left side and the subclavian that supplies the upper extremity of the left side. There are really two large arteries supplying each side, but on the right they arise from the one branch from the aorta, while on the left side the arteries going to the head and to the upper extremities are separate. The thoracic aorta lies close to the spinal column in the chest. It supplies arteries extending to the walls of the chest and to all the viscera in the thorax, lungs, etc., save the heart. The abdominal aorta supplies the diaphragm, the muscles of the walls of the abdomen, the liver, kidneys, spleen, stomach, pancreas suprarenals, the small and large intestines, the spermatic vesicles and a part of the pelvis. The two great branches into which it finally divides supply the pelvic walls, the organs in the pelvis, the external genitals and finally the lower limbs. There are a number of variations in the details of the distribution of the different large vessels of the aorta, but these concern the anatomist. The walls of the aorta resemble in their microscopical structure those of the arteries of the body save in possessing more elastic fibrous tissues. This is necessitated because of the greater pressure on this part of the circulatory apparatus. See ARTERY; CIRCULATION; HEART.

AOSTA, ā-ōs'tą, Italy, town in Piedmont, 50 miles northwest of Turin. It is the seat of a bishop, and possesses a collegiate and three parish churches, two colleges and two hospitals. Among its antiquities are a triumphal arch, erected to the memory of Augustus who rebuilt the town and gave it the name of Augusta Prætoria; a gate with three arches, and the remains of an amphitheatre, and the old Roman walls which still surround the town. It has some trade in wine, cheese, hemp and leather.

AOUDAD, ā'oo-dăd, or **ARUI**, a somewhat goat-like wild sheep (*Ovis tragelaphus*), inhabiting the Atlas Mountains of northern Africa. It is about three feet in height, and its horns, which resemble those of the bharal are about two feet long. It is especially characterized by the long whitish hair depending from the throat, chest and forelegs, but elsewhere its coat is short and light brown, enabling it to hide easily among the rocks of its mountain home. Many other names are given to it, as "ruffed moufflon," "bearded argali," "kebsh" (Egypt), "tidal" or "teybal," and "beden" (Nubia). It is a common resident in menageries, where it breeds readily.

AOUL, the finest of the Somaliland gazelles (*Gazella sœmmerringi*), with massive lyrate horns. Its height is about 30 inches, and the borders of the ears and face are strikingly marked with black.

APACHE, ą-pä'chē (Pima, "enemy"), the name of a large Indian tribe of the Athabascan stock, kindred of the Navajos, and originally occupying the region from central Texas to the Colorado River in Arizona. The Spaniards applied the name, borrowed from the Pimas, to all the races just north of Mexico, whom they classed as Apachés de Xila, Apachés de Navajo, and Apachés Vaqueros, the first-named being our Apaches. When the United States by the Gadsden Purchase (q.v.) first came in contact with them they numbered about 10,000 and had long been at mortal feud with the Mexicans. For a few years they gave the Americans relatively little trouble of an acute kind, but after a serious raid in 1857 it was urged by those with knowledge that they should be settled north of the Gila, taught industries, and watched. This was not done, however, and in 1860 the whole tribe went on the warpath. The next year the Civil War caused the troops to be withdrawn, and in a short time the Apaches had murdered or driven out every white inhabitant of the Arizona Territory except a few hundred who took refuge in Tucson. For nearly 10 years the Territory was the scene of one of the most awful Indian wars in history, which practically stopped all progress there. On the Indian side it was entirely an affair of ambushes or of sudden raids from mountain strongholds, with burning and slaughtering, and carrying off of captives to be mutilated or outraged and then tortured to death. About a thousand men, women and children perished. Military operations were repeatedly stopped for a considerable period by the government commissioners, who wished to institute a policy of kindness, but finally Gen. George H. Crook was allowed to proceed without interruption in 1872–74, and put an end to the operations of the bands as a whole in 1874. But the government policy of concentrating them all on one reservation of San Carlos, Arizona., had unfortunate results. They objected to live with other bands with whom they were as much at feud as with the whites, and also to leave their chosen districts once given them by the government; but both General Crook and his successor,

who opposed the transfers, were removed to other departments. Again and again the bands escaped while being removed, and renewed their outrages; and for six years more there was a succession of bloody raids which swelled the total of horrors in the unfortunate Territory and New Mexico. In 1882 Crook was restored, and by tact and their confidence in him induced about 1,500, or over a fourth of them, to live on the reservation without rations. But the rest liked their life much too well to give it up; repeatedly they surrendered and returned with Crook only to break their promise and return to the warpath. The last time was in March 1886, when they escaped before entering Arizona and continued their outrages along the border for five months. The uproar against Crook for being duped (he had upheld the essential justice of their cause, and his belief in their willingness to behave, against the people) caused his replacement by Gen. Nelson A. Miles, who finally cornered the band and forced it to surrender. But the attempt to settle the Chirichuas and Hot Springs bands — the fiercest Indians on the continent, according to General Crook — on a reservation in Arizona roused such a storm of protest from Arizonians that they were removed to Florida instead, then to Alabama, and finally to Fort Sill, Okla., where they still remain, to the number of some 300. In all there are now about 5,200 Apaches. The name is sometimes applied to the Jicarillas, Mescaleros and Lipans by reason of linguistic affinities; but incorrectly. Consult Bancroft, 'Native Races of the Pacific States' (Vol. XVII, 1880).

APALACHEE, ăp-ą-lă'chē, or **APALACHI,** a tribe of Indians of the Muskhogean stock, first mentioned in 1526 as occupying the territory about Apalachee Bay and Saint Mark's River in northwestern Florida and northward to the mountains to which they have given their name. Near the end of the 16th century Spanish Franciscan friars founded missions among them, till the war of the Spanish Succession, a century later, when the Spanish attempted to use the Indians as allies against the English Carolinas. Twice before the Spaniards had invaded Carolina from Saint Augustine; and now, in 1702, they headed a party of 900 Apalachees and marched into Georgia. The Creeks, who were friendly to the English, not only warned them, but a party of 500 ambushed the Apalachees and routed them with great slaughter. The Carolinians determined to take the offensive and after a fruitless expedition to Saint Augustine in December 1703 one was undertaken into the Apalachian territory, which supplied that city with provisions and contained many Spanish forts. With 50 white men and 1,000 Creeks its leader stormed one fortified town and won a sharp battle, capturing several hundred Indians with women and children. Five other towns surrendered unconditionally, while a powerful cacique capitulated for his own safety. The expedition returned in March 1704 with 100 Indian slaves and 1,300 free Indians, who were settled among the Creeks. Twice more within the next four years Carolina invaded this territory with such results that in 1708 it held 850 Indian slaves in addition to what had been given to the Creeks. The Apalachees were thus practically obliterated; and though for a time they maintained their individual existence they finally became merged with the Creeks. Consult McCready, 'History of South Carolina under the Proprietary Government' (1897).

APALACHEE, ă'pa-lă'chē, **BAY,** a large arm on the south coast of Florida, in the Gulf of Mexico, having a breadth of about 90 miles and an extent inland of 50 miles. At the mouth of the Saint Mark's River, which flows into the bay, is the town of Saint Mark's.

APALACHICOLA, ă'pą-lăch-ĭ-kō-lą, Fla., city, port of entry and county-seat of Franklin County, on Saint George Sound (Gulf of Mexico), at the mouth of the Apalachicola River; 85 miles southwest of Tallahassee; on the Carrabelle, Tallahassee & Georgia Railroad and the following lines of steamships: Plant; People's; Merchants and Planters'; Gulf Navigation Company; Central Gulf Coast Company; and the Apalachicola and Chipola River line. The city has an important trade in timber and naval stores. The value of its foreign commerce in 1901 amounted to $370,000, the most of which was in export trade. The city has one national and several private banks. Pop. (1910) 3,065.

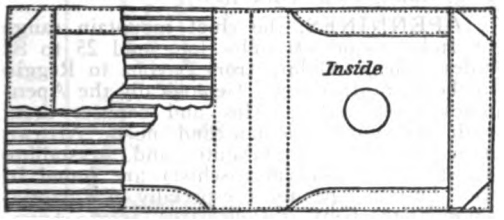
APALACHICOLA, a river flowing from southeastern Georgia across Florida and entering the Gulf of Mexico through Apalachicola Bay. It is navigable throughout its length of 90 miles and is formed by the union of the Flint and Chattahoochee rivers.

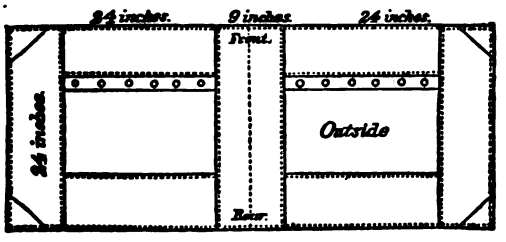
APANAGE, or **APPANAGE,** an allowance formerly received by the younger princes of a reigning house in which the right of primogeniture prevailed, from the revenues of the country. It consisted mostly in money, with the use of a residence and hunting grounds, attended frequently with the right of jurisdiction over these domains.

APAR, ă'pär, the three-banded armadillo (*Tolypeutes tricinctus*), which has three movable bands and is one of the small species able to roll itself into a ball. See ARMADILLO.

APAREJO, ą'pär-ā'hō. This pack-saddle, most generally used in military service, consists of a strong leather sack, about two feet wide and from 55 to 60 inches long, according to the girth of the animal. A seam running from the front to the rear of the aparejo divides it into two equal parts, each of which is composed of a double layer of hide, with sufficient space between to introduce a suitable stuffing of hay, grass, moss, fibre, etc. These side-flaps, when fastened together at the top, form a ridge within which the backbone of the animal rests free from friction or pressure. On the inside of each flap is left a circular hole through which the stuffing material can at any time be reached. The careful packer should keep the stuffing evenly distributed, or so as to vary with the conformation of the back of the particular animal, as portions of it are constantly shifting and working up into lumps, in consequence of the travel. The drawings show the interior and exterior of the aparejo. To *set up* the aparejo, or to give it evenness and stiffness, small ash, rose or willow sprouts from one-half to three-fourths of an inch in diameter and as long as possible without springing (any tough and elastic wood will answer), are placed inside of it and at equal distances apart — about two

inches. On the inside of these and toward the animal coarse grass or hay (such as is light and tough and will not break up) is placed layer after layer until the sides are as full as possible. The corners should be stuffed as hard as possible by means of a sharp stick. Serious trouble is often experienced on long and toilsome marches from loss of flesh, causing the aparejo to fit badly and cause a sore back. Great care must be taken to make good all deficiencies in the stuffing, and when the aparejo is too large to be adapted to a thin animal by stuffing a portion should be cut out of the centre. Straw pads are useful for protecting the hips and withers when placed under the cinches of those animals carrying rough loads.





When the aparejo is stuffed it should be put on the animal for which it is intended and the crupper adjusted. The shape of the apparejo enables all loads to be nicely balanced. One hundred pounds on one side may be made to ride with 50 pounds on the other without straining the animal. It presents much more surface for pressure to the animal than any other form of pack-saddle. The lower corners secure the lash-rope and prevent it slipping when on the road. By removing the hay or stuffing from the side a sore back may be easily remedied and by properly adjusting the filling the aparejo may be made to perfectly fit a badly-shaped back. These may be cited as some of its advantages.

APARRI, ą-păr'rę, Philippines, town of the Cagayan province, on the river Cagayan, near its mouth. Pop. 11,265.

APARTMENT HOUSE, the term used in the United States to designate a structure intended to accommodate several families, each in its own set of rooms, which form a separate dwelling. Such structures are of comparatively recent introduction, but houses of this kind have long been built in Europe. In New York and other American cities there are now great blocks of such houses, which provide excellent and commodious dwellings at a lower rent than if each were a separate building. See ARCHITECTURE, AMERICAN.

APATELITE (from the Greek *apatelos*, "deceitful"), a mineral related to raimondite, occurring in small yellow, friable nodules in the immediate vicinity of Paris, France. It has the probable composition $4Fe_2O_3.6SO_3.3H_2O$.

APATITE (from the Greek word *apate*, "deceit," in allusion to the fact that apatite is often confused with other minerals), a native phosphate of calcium, combined with fluorine or chlorine and crystallizing in the hexagonal system, though also occurring massive. The crystals have a specific gravity of about 3.2 and a hardness of 5. Apatite is usually green, but it may occur white or strongly red, yellow, brown, or blue. The common variety has the formula (CaF) $Ca_4(PO_4)_3$ and is known as "fluor-apatite"; but the fluorine is sometimes replaced to a considerable extent, or even wholly, by chlorine. In such cases the mineral is known as "chlor-apatite." A variety called "manganapatite" is also known, in which the calcium of the typical mineral is partially replaced by manganese. Apatite is widely distributed, particularly as segregations in pegmatite dikes. The Canadian apatite occurs massive or in large crystals. It was formerly extensively mined as a fertilizer, but its use has now been almost entirely supplanted by the "rock phosphate" of Florida, South Carolina and Tennessee.

Apatite Group.— In mineralogy, a group of minerals crystallizing in the hexagonal system and consisting of arsenates, phosphates and vanadates of calcium and lead, associated with chlorine or fluorine. It contains apatite, pyromorphite, mimetite, vanadinite, hedyphane, pleonectite and svabite.

APE (A. S. *apa*, Ger. *Affe*), in modern usage, a term describing an Old-World tailless monkey, such as the gorilla, orang-utan, chimpanzee or gibbon, but originally an exact synonym for monkey and applied to any quadrumanous animal except the lemurs. For examples of this older usage see BABOON; MACAQUE; MONKEYS. In its modern sense it applies particularly to the family *Simiidæ*, or anthropoid apes, found in the forests of the equatorial regions of the Old World and called "anthropoid" on account of their great resemblance to man. This likeness is especially marked in young individuals before the face has attained its full brutality of expression, the canine teeth their great size, and the skull its final thickening and growth into crests and ridges. Except for the shape of the jaw (which, instead of being curved, comes to a noticeable angle on each side with a canine tooth at the apex of each angle) and for the development of the skull already mentioned, as well as for the relative length of the arms and shortness of the legs and the fact that the great toe is short and more or less opposable to the other fingers, an ape's skeleton is practically the same as man's though larger and heavier in proportion to the body and lacking certain curvatures of the spine which adapt the human frame to ease in an erect position. The braincase and the brain itself are much smaller than in man, yet similar in development and the brain is much convoluted. The teeth are of the same number as man's and of like character. In certain divergences of structure exhibited between the inferior families of monkeys and man, the ape resembles man and differs from the monkeys.

The gibbons (noticeable for standing erect with less difficulty than any other apes), the chimpanzee (which has the largest brain), the gorilla, and the orang-utang, together with several extinct and fossil species, make up the anthropoid apes. All are clothed with hair on all parts of the body except the face and palms; they have no cheek-pouches, no tail and either no trace or but very slight traces of the naked spots or callosities seen upon the buttocks of the lower apes. All are as large or larger than man and all can walk upright, though they are more at ease in climbing than in walking. When on the ground they make their way slowly, sometimes closing the hands in order to walk on the knuckles instead of the palm and either similarly closing the foot or walking on its side. Their food is mainly vegetable, yet their great strength, their intelligence and their savage nature place them among the most dangerous of wild animals. See CHIMPANZEE; GIBBON; GORILLA; ORANG-UTAN; PITHECANTHROPUS.

APEGA, the wife of Nabis, a tyrant of Sparta, who invented an infernal machine which he called after his wife, "Apega." It was a box exactly resembling his wife in her royal apparel, but the interior was full of spikes which wounded the victim enclosed in almost every part of the body. The "Iron Virgin" was a similar instrument employed by the Inquisition. It represented a woman of Bavaria and the spikes were so arranged as to pierce the least vital parts in order to prolong the sufferings of the victim enclosed.

APEL, ä'pĕl, **Johann August,** German author: b. Leipzig 1771; d. 1816. His 'Gespensterbuch' and 'Wunderbuch' were both popular, the former containing the bases for the text of Weber's opera of 'Der Freischütz.' His 'Metrik,' which includes a survey of ancient prosody is his best-known work.

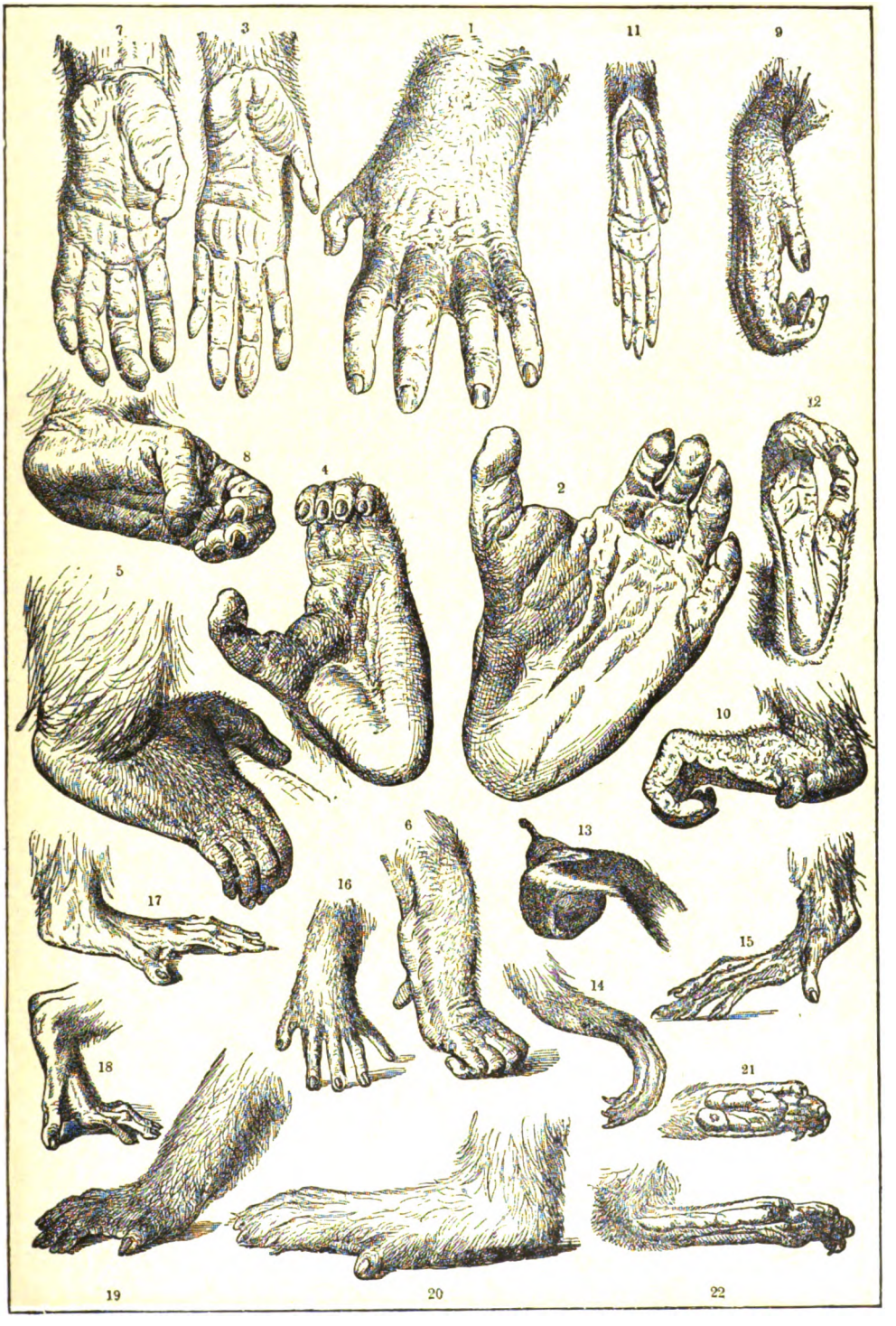
APELDORN, ä'pĕl-dôrn, or **APELDOORN,** a notably attractive town of Holland, province of Guelderland, 17 miles north of Arnhem; with manufactures of paper, morocco leather and copper-plates. The Loo, a favorite palace of the late King of Holland, is at Apeldorn. Pop. about 28,000.

APELLES, the most famous painter of ancient Greece and of antiquity: b. in the 4th century B.C., probably at Colophon. He first studied at Ephesus, under Ephoros, and attracted by the renown of the Sicyonian school, he studied later at Sicyon. In the time of Philip he went to Macedonia and there a close friendship between him and Alexander the Great was established. The most admired of his pictures was that of Venus rising from the sea and wringing the water from her dripping locks. His portrait of Alexander with a thunderbolt in his hand was no less celebrated. His 'Anadyomene'; 'Artemis Surrounded by Maidens'; and 'Slander' were also famous and the detailed description of them by Lucian inspired later artists, among others Botticelli and Dürer. He appears to have returned to Asia after Alexander's conquests. He visited Protogenes at Rhodes and admired his work. He was noted for his just appreciation of his rivals. His industry was unremitting, especially in drawing, so great as to give rise to the proverb "No day without a line." He is also the subject of many anecdotes, among which may be cited his reproving the cobbler. It was Apelles' habit to listen to the criticisms of the common people of his pictures by concealing himself nearby. A cobbler, having pointed out a fault in the shoe of a figure, Apelles rushed out and rectified it, but when the cobbler later criticized the legs of the figure Apelles told him to stick to the shoes, or, as the proverb has it, "Let the cobbler stick to his last." His renown was at its height about B.C. 330, and he died near the end of the century. Consult Houssaye, 'Histoire d'Appelles' (Paris 1867); Wustman, 'Apelles' Leben und Werke' (Leipzig 1870); Woltmann and Woermann, 'History of Painting' (Vol. I, Eng. trans., New York 1886).

APENNINES, the chief mountain range of Italy, about 800 miles long and 25 to 85 miles wide, extending from Savona to Reggio in the form of a bow. Geologically the Apennines resemble the Alps and connect them with the north Sicilian and north African mountain ranges. Granite and crystalline schist (gneiss and mica-schist) are found in the Ligurian Apennines, especially in Calabria, south of the Gulf of Policastro. In the Apennines proper these older crystalline formations are entirely lacking. They consist principally of limestone, dolomite, sandstone, and marl, of the Chalk and Tertiary formations, in which occur strata of serpentine in the north, and sometimes trachyte and basalt, especially on Mount Vulture. In the northern Apennines and also in the Tuscan highlands, there are large quantities of marl, shale and blue-gray sandstone, which belong in part to the Chalk formation and in part to the early Tertiary. Limestone is found in large quantities in the composition of the whole mountain range. Carboniferous, Permian, Triassic and Liassic deposits occur in the Apuan Alps, the famous marble of Carrara belonging to the Liassic or Triassic period. The Apennines are divided into six parts, according to the regions through which they pass and these fall into three groups, the northern Apennines (including the Ligurian and Etruscan); the middle Apennines (the Roman Apennines and the Abruzzi); the southern Apennines (the Neapolitan and Calabrian). The Ligurian Apennines reach from the Col de Tenda, the geological boundary of the Alps, to the Pass of Cisa (about 700 miles). The southern slope falls abruptly to the sea, the northern slope gradually, with many valleys, toward the river Po. Numerous passes lead from the coast towns over the range, among them the Bochetta Pass and the Giovi Pass from Genoa; and the Genoa-Alessandria Railroad has cut a tunnel through near the last named pass. From there to the east the range almost doubles its width and increases in height. The eastern half, consisting of several parallel chains, is difficult to cross and a serious hindrance to transportation. In this portion there are practically no thoroughfares except the railroad from Parma to Spezia.

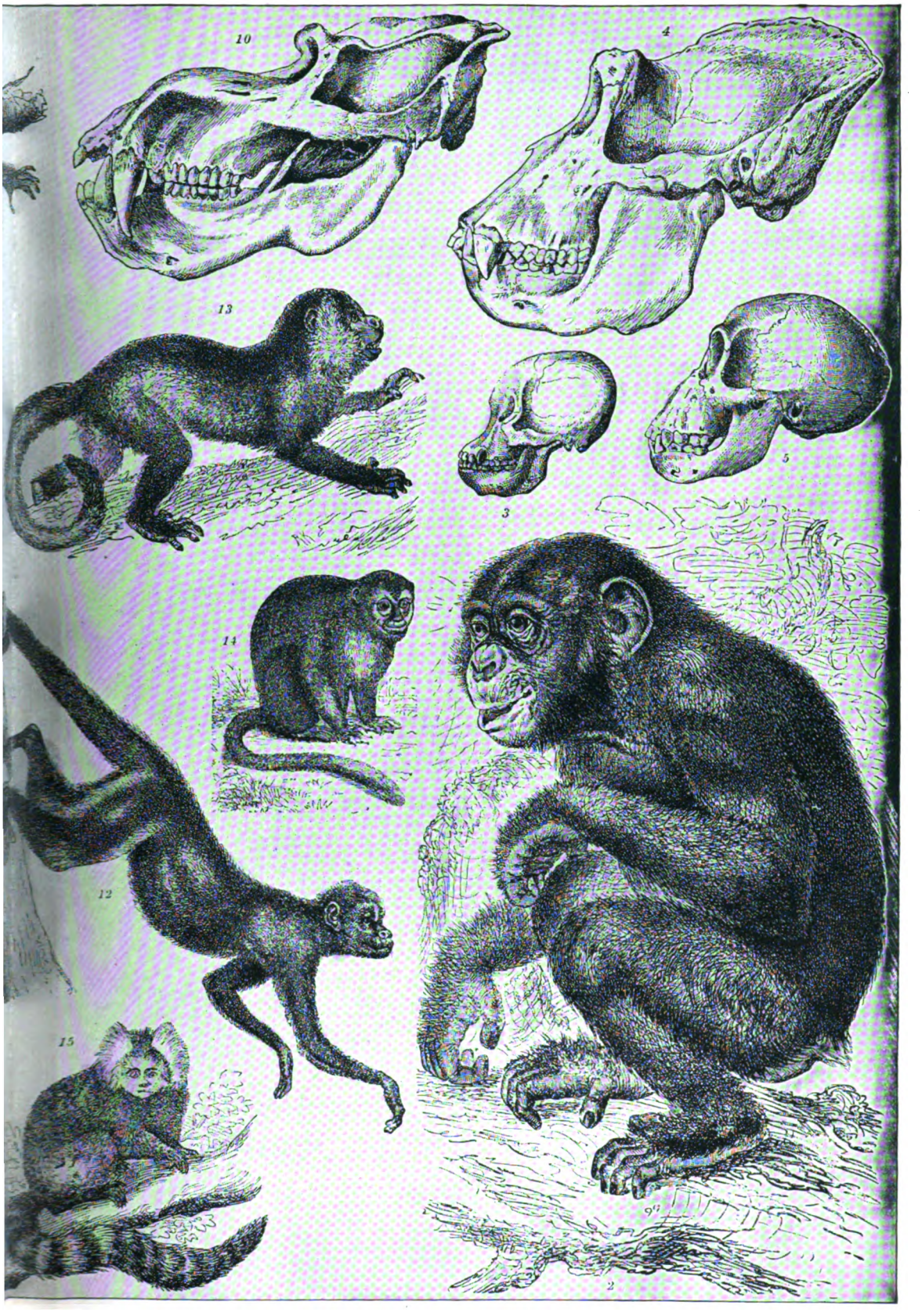
The Etruscan Apennines, extending to the valley of the Metauro, have a southeasterly direction throughout and consist of several ranges, one in front of the other, like the links of a chain. The most noted peaks are in the northern part, the Alpe de Succiso (about

HANDS AND FEET OF APES



1–2 Gorilla
3–9 Chimpanzee
10 Orang-Utan
11–13 Gibbon
14–15 Guereza
16–18 Barbary Ape
19–20 Dog-faced Baboon
21–22 Night Ape

Fig. 1 Skeleton of young Orang-outang 2 Chimpanzee 3 Skull of young Chimpanzee 4 Skull of old Gorilla 5 Skull of yo
11 Black Howler 12 Coaita 13 Capuci



Gorilla 6 Kahau or Proboscis Monkey 7 Mona Monkey 8 Magot or Barbary Ape 9 Mandrill 10 Skull of Baboon
Monkey 14 Night Monkey 15 Marmoset

6,600 feet), Mount Cusna (over 6,900 feet) and Mount Cimone (7,103 feet), the latter being the highest peak in the northern Apennines. The northern portion includes the Apuan Alps, bounded by the valley of the Serchio, the Magra and the Antella, which reach the height of about 6,400 feet in Mount Pisano and are of pure marble (Carrara) on the slope toward the sea. The most important thoroughfare of the Etruscan Alps is the railroad from Bologna to Florence, which passes through a tunnel near Prachia; the La Fluta Pass, over which the road from Florence to Bologna passes, should also be mentioned. The Roman Apennines, beginning between the valleys of the Tiber and the Metauro, extend to the valley of the Tronto and Belino and consist of numerous parallel chains. In the north the main peak is Mount Catria (about 5,420 feet); in the south, the chain of the Sybilline Mountains rise to the height of 5,100 feet (Mount Vittore). The formation of the range here renders the crossing easy and the railroad from Ancona to Florence and Rome crosses here. The Abruzzi extend southward from the valley of the Tronto and in their eastern chain in Gran Sasso' d'Italia reach the greatest height in the whole Apennines (Mount Corno, 9,585 feet). The western chain, which, with the eastern, encloses the Plain of Aquila, has a height of almost 8,150 feet (Mount Velino) and south of the Pescara tunnel is the Majella range with a height of 9,200 feet. The Neapolitan Apennines extend from the valley of the Sangro and Volturno to that of the Crati, but their altitude is much less than that of the middle Apennines, the Matesian Mountains reaching the height of over 6,700 feet in Mount Miletto. Rounded, wave-like shapes prevail in this range. On the eastern range is the extinct volcano of Mount Vulture. The roads and railroads from the west to the east coast encounter no particular difficulty in crossing this range. In the south the Apennines reach again a noticeable height in Mount Pellino (7,450 feet) and slope abruptly to the valley of the Crati. The Calabrian Apennines consist of a small chain sloping abruptly to the Tyrrhenian Sea and of the granite plateau of the Silagian Mountains with a mean height of 3,000 feet. This north Calabrian mountain land is separated from the south Calabrian by a neck of land between the Gulf of Santa Eusemia and the Gulf of Squillace. The outer northerly and northeastern slope of the Apennines is gradual, the eastern slope almost everywhere so abrupt that on the Adriatic coast there is only room for a road. Since the Apennines to the west of the Gulf of Salerno lie near the coast, but in the north extend farther and farther away from it, there exists a three-cornered space in which lie the so-called Lower Apennines. The volcanic formation is especially characteristic of these mountains and these regions are the classic ground of present and former volcanic action. Therefore there are here active and extinct volcanoes and hot springs, among them the springs of Voltena. The Lower Apennine region is divided into several parts by the broad valleys of the rivers flowing from the Apennines. Of these divisions the Tuscan highland is the most noted, ending on the south at the lower Tiber. In the interior are fertile plains sloping gently toward the valley of the Arno; in the west the highlands end with an abrupt slope, between which and the coast lie the plains of Maremma, from which rise a few single peaks. The part of the Lower Apennines between the valleys of the Tiber and the Garigliano includes two small mountain-groups: the Alban Mountains, famed for their beautiful scenery, and the Volsker Mountains extending as far as the coast near Terracina. West of these Volscian Mountains lies a plain whose northern portion includes the Campagna of Rome, while the southern part contains the Pontine marshes. The southernmost part of the Lower Apennines extends from the Garigliano to the mountain range of Castellamare, north of Salerno, and includes the plain of Campagia, noted for its fertility as well as its beauty. From this plain rise several single volcanoes, including the extinct Mount Della Croce in the north and Vesuvius (4,200 feet) in the south. The climate is on the whole more severe than would be expected from the latitude and the position of Italy, while the heat in summer reaches a degree almost unendurable in the low and sheltered valleys, and palms and other tropical vegetation can thrive on almost all the west coast; neither fruit nor grain grow on the exposed, windy heights, with their elevation of over 3,000 feet, and the trees are few and stunted. The region of vegetation may be divided into four sections: (1) The olive region to the 1,500-foot elevation, with Mediterranean flora, garden plants and winter pasturage; (2) the region of the chestnut and oak, to the elevation of 3,000 feet with agricultural products and chestnut woods; (3) the region of the beech and coniferous trees at the height of 3,000 to 6,000 feet; (4) the region of the shrubs and Alpine plants with summer pasturage extending to the highest peaks. In climate, therefore, the northern Apennines form a line of separation between north and south; only on their northern slopes does Italy really begin. The northern part only presents great difficulties in traveling. The mountains are now traversed by several railroads, mostly by means of tunnels.

APENRADE, ä'pĕn-rä'dĕ (Danish, *Aabenraa*), seaport of Prussia, in the district of Schleswig-Holstein, on the Little Belt and in the Bay (fjord) of Apenrade. It is beautifully situated in a deep valley surrounded by woody heights and a fertile country. Apenrade has a school of navigation and carries on a considerable seafaring trade. It is a popular bathing resort and is a place of considerable antiquity. Pop. about 7,000.

APERTURE, *in anatomy, zoology, botany, etc.* The aperture of a univalve shell is the opening or mouth. In mollusks which feed on vegetable matter it is entire; while in those which are animal feeders it has a notch or canal. In some families it has an operculum or cover. The margin of the aperture is called the peristome. *In optics,* see MICROSCOPE; TELESCOPE.

APE'S HILL (Arabic, *Jebel Zatut*), the ancient Abyla, the extremity of a mountain range in northern Morocco, opposite Gibraltar, and one of the «Pillars of Hercules.»

APEX, in mining, the highest point of outcrop of a mineral vein or lode. This is the

common definition of the term as used by miners, although its legal significance must be interpreted in connection with the local conditions and cannot be defined in general terms. According to the Revised Statutes of the United States for 1872 the owner of a mineral claim which includes the apex is allowed to follow the vein along the dip for an indefinite distance without regard to the ownership of the overlying surface, so that the proper location of the apex is of the utmost importance in establishing the lines for a claim. It has been decided by the courts that the apex need not appear necessarily at the surface, and hence the term does not exactly coincide with the term outcrop. In the case of an inclined vein whose apex is concealed, but which outcrops at some point lower down, the right of mining is conveyed to the owner of the apex-claim in preference to the owner of the outcrop-claim. This law has been the cause of much confusion and of expensive litigation in settling the ownership of valuable mining properties in the Western States. A wiser provision is that obtaining in most European countries, which grants the owner the right of mining only within the vertical limits of his claim.

APEX OF THE SUN'S WAY, a term signifying the point in the constellation Hercules to which the sun's motion in space is directed. This point is about in right ascension 18 hours 30 minutes, and declination 35° north. The point is therefore somewhat south of the zenith for the most of the United States in the early part of the evenings of August. Of course this statement is meant to indicate the locality only in the most general way. That the solar system is moving toward this part of the heavens is indicated by the apparent spreading apart of the stars in this region, together with an apparent crowding together of the stars in the opposite direction, as the trees open in front of one walking through a grove and shut together behind him. The velocity of this motion is shown by spectroscopic observation to be about 11 miles per second. The movement, so far as observed, seems to be in a straight line, but may turn out to be in a vast curved orbit.

APHANESITE, a-fan'e-sīt (from the Greek *aphanes,* "obscure," in allusion to the difficulty of recognizing it by its crystals), a mineral now better known as clinoclasite.

APHANIP'TERA, an order of wingless insects having a sucker of three pieces and a true metamorphosis. The thorax is distinctly separate from the abdomen, and two horny plates mark the spots where wings would be in the higher insects. It contains the *Pulicidæ,* or fleas.

APHANITE, ăf'ă-nīt (derivation same as for aphanesite), a variety of the rock known as diorite, in which the constituent minerals occur in such small grains that the aggregate rock appears almost (or quite) homogeneous, except when examined through a lens.

APHASIA, ą-fā'zhī-ą, the designation of a disorder of speech due to disturbance of the brain mechanism independently of any muscular defect. This mechanism is complex and is usually divisible into two parts, the receptive or sensory and emissive or motor. To the former belong those parts of the brain that store concepts of spoken words or written words; to the latter those parts concerned in co-ordinate speech or in writing. Thus aphasia may be of at least four different and independent types. Frequently it is a combination of one or more of these. The zones in the brain that store intellectual auditory impressions are located in the first temporal convolution. Any injury to this part of the speech mechanism may produce auditory aphasia or word deafness. A patient thus affected is able to hear words and to speak, but he does not comprehend what is being said to him. He has lost his hearing word memories, and his own language is as a foreign language that he hears but cannot comprehend. In an analogous manner, if there is disorder of the occipital lobes, about the calcarine fissure, or of its related fibre tracts, a patient may have visual aphasia or word blindness. His own written language might as well be in Arabic, for he has lost all his memory of written words. These types of aphasia are much less common than the true type of motor aphasia or aphemia. In this the trouble is in the third left frontal convolution in the brain, Brocas convolution, or its related fibre tracts, and a patient thus affected has lost the power to say the words he desires to say. He is perfectly able to talk, may repeat words, but knowing in his mind precisely what he wishes to say is unable to express it, not because of any failure of the muscular power of the tongue to articulate, but because of the defect in the storage centre or its fibre paths for motor speech. A fourth type is *agraphia,* in which the affected patient is unable to write with understanding the words with which he is familiar. The site of the lesion here is undetermined. It usually accompanies motor aphasia. There are also forms of combined aphasia in which the fibre tracts from one centre to another are cut off. These make paraphasias, and their symptoms are extremely complex. Aphasia in its various forms may differ very widely in its extent. It may be very slight or very profound. It may be temporary or permanent, depending on the nature and extent of the brain injury. Aphasia is most frequently a symptom of hæmorrhage from some artery or arteries in the brain; it may be caused by the growth of a tumor or result from an injury. The treatment is that of the causing disease. In the sensory aphasias education of the non-affected areas is of great importance. If there is word blindness, the memory for spoken symbols should be cultivated, and vice-versa.

Bibliography.— Baldwin, 'Dictionary of Philosophy and Psychology,' article entitled "Speech and Its Defects" (1903); Bastian, 'Aphasia and Other Speech Defects' (1898); Elder, 'Aphasia and the Cerebral Speech Mechanism' (with bibliography, 1897); Gould and Pyle, 'Cyclopedia of Medicine and Surgery' (Philadelphia 1912); Jelliffe and White, 'Diseases of Nervous System' (1917).

APHE'LION, that part in the orbit of the earth (or any other planet) which is farthest from the sun.

APHELIOTROPISM, the form of sensitiveness in planets by which their organs direct

their axes away from the source of light. See HELIOTROPISM.

APHEMIA, a term employed to designate a motor aphasia. See APHASIA.

APHID, a plant-louse of the family *Aphididæ,* order *Hemiptera.* Aphides are among the most abundant of insects and do much injury to vegetation by their habit of sucking the sap of leaves and stems of plants. They are usually very small, never over a quarter of an inch in length. Their mouth-parts form a slender beak adapted for puncturing leaves and sucking the sap. Their antennæ are from three to seven-jointed, and generally longer than the body. The ocelli are usually present, and the beak is three-jointed and developed in both sexes. The legs are long and slender, with two-jointed tarsi. The males and females are winged, and also the last brood of asexual individuals, but the early summer broods are wingless. Their bodies are flask-shaped, being cylindrical, the abdomen thick and rounded, and in aphis and lachnus provided with two tubes on the sixth segment for the passage of a sweet fluid (honey-dew) secreted from the stomach, which attracts crowds of ants (see ANT). The wings are not net-veined, having few veins, which pass outward from the costa. They are usually green in color with a soft powdery bloom exuding from their bodies. Bonnet first discovered that the summer brood of wingless individuals were born of virgin parents, hatched from eggs laid in the autumn, and that the true winged sexes composed the last generation, which united sexually, and that the female laid eggs in the autumn which produced the spring brood of asexual wingless individuals.

In the early autumn the colonies of plant-lice are composed of both male and female individuals. These pair, the males then die, and the females begin to deposit their eggs, after which they die also. Early in the spring, as soon as the sap begins to flow, these eggs are hatched, and the young lice immediately begin to pump up sap from the tender leaves and shoots, increase rapidly in size, and in a short time come to maturity. In this state it is found that the whole brood, without a single exception, consists solely of females, or rather, and more properly, of individuals which are capable of reproducing their kind. This reproduction takes place by a viviparous generation, there being found in the individuals in question young lice which, when capable of entering upon individual life, escape from their progenitors and form a new and greatly increased colony. This second generation pursues the same course as the first, the individuals of which it is composed being, like those of the first, sexless, or at least without any trace of the male sex throughout. These same conditions are then repeated, and so on almost indefinitely, experiments having shown that the power of reproduction under such circumstances may be exercised, according to Bonnet, at least through nine generations, while Duval thus obtained 11 generations in seven months, his generations being curtailed at this stage not by a failure of the reproductive power, but by the approach of winter, which killed his specimens. Huber observed that a colony of *Aphis dianthi,* which had been brought into a constantly heated room continued to propagate for four years in this manner without the intervention of males, and even in this instance it remains to be proved how much longer these phenomena might have been continued.

Certain species feed on the roots of plants, as asters, lettuce, grasses, etc., and these also attract numerous ants. The corn plant-louse has been found by Forbes to hibernate in the wingless, asexual form in the earth of previously infested corn-fields. In the spring an ant (*Lasius alienus*), which runs its tunnels along the principal roots of the corn, collects the aphides and conveys them into its galleries, where they are watched and protected. The white-pine aphis (*Lachnus strobi*) is destructive to young white-pine trees. Another aphid is the grape *Phylloxera* (q.v.). The woolly aphids (*Schizoneura tessellata*) flock on the stems of the alder, their bodies concealed by a flocculent mass of wax. Another destructive species is the apple woolly louse (*S. lanigera*). Aphides can be exterminated by frequent spraying.

Bibliography.— Buckton, 'Monograph on British Aphides' (Ray Society, London 1879–83); Miall, L. C., 'Injurious and Useful Insects' (London 1908); Osborn, Herbert, 'Agricultural Entomology' (Philadelphia 1916); Thomas, 'Eighth Report of State Entomologist of Illinois' (Springfield 1879).

APHONIA, medical term used to designate a loss of voice more or less complete. It may result from paralysis of the respiratory muscles, pneumonia, or pulmonary emphysema, or from diseases of the larynx, œdema of the glottis, polypus, etc., or by pressure on the larynx caused by abscesses or any morbid growth. In general it is caused by anything which interferes with expiration or with the functions of the vocal cords. It differs from mutism, in which is lost the ability of forming articulate sounds. Aphonia may exist in varying degree according as the voice is totally or partially lost, and is very often associated with hysteria.

APHRODISIACS, ăf'rō diz'ĭ-ăkz, drugs that excite erotic desire. True aphrodisiacs are rare and their use is attended with considerable danger. The principal are hashish, cantharides, blatta orientalis, and damiana. Drugs with an opposite effect are known as anaphrodisiacs.

APHTHÆ, ăf-thą, small round ulcers surrounded by a red border which appear on the mucous membrane of the mouth in the disease known as aphthous stomatitis. The ulcers usually appear on the under surface or sides of the tongue or in the fold between lips and gums. Aphthæ attack children during the dentition period, when lowered vitality is often a predisposing cause. Unclean nursing bottles and faulty oral hygiene are also factors in inducing an attack. It is not known to be contagious and as far as known there is no specific germ connected with the disease. Cleansing the mouth with antiseptic washes, treating the ulcers with caustics, such as nitrate of silver, and strict attention to oral hygiene are the usual methods of treatment.

APHYDROTROPISM, a form of sensitiveness by which a plant organ turns its axis away from the source of moisture. It is observed in the fruiting bodies of several fungi.

The vegetative filaments remain in the moisture but the reproductive filaments grow out into the drier air.

APIDÆ, the family of *Hymenoptera* including the bees. It is characterized by its members being clothed with feathered hairs, and by having the basal segment of the hind foot flat and broad. The family is very numerous and is world-wide in range. See BEE.

APIS (Egyptian *Hapi*), a bull at Memphis to which divine honors were paid by the ancient Egyptians, and which was regarded as the representative of Osiris. It was necessary that he should be black, with a triangle of white on the forehead, a white spot in the form of a crescent on the right side and a sort of knot like a beetle under his tongue. Other marks are also mentioned. When a bull of this description was found he was fed four months in a building facing the east. At the new moon he was led to a splendid ship with great solemnity, and conveyed to Heliopolis, where he was fed 40 days more by priests and women, who performed before him various indecent ceremonies. From Heliopolis the priests carried him to Memphis, where he had a temple, two chambers to dwell in, and a large court for exercise. His actions were thought to have prophetic significance, and he was believed to impart prophetic power to the children about him. His birthday was celebrated every year, when the Nile began to rise. The festival continued for seven days, and it was said that the crocodile was always tame as long as the feast continued. Notwithstanding all this veneration, the bull was not suffered to live beyond 25 years, the reason of which is probably to be found in the astronomical theology of the Egyptians. The death of Apis, however, excited universal mourning, which continued till the priests had found a successor to him. As it was extremely difficult to find one with all the above distinctions, fraud was often practised by the priests.

APJOHNITE, a native manganese alum, or hydrated sulphate of aluminum and manganese, found in fibrous form and as incrustations at Lagoa Bay, South Africa, and in Sevier County, Tenn. It is variable in composition, but some analyses indicate $MnSO_4.Al_2(SO_4)_3+24H_2O$. It is usually white or nearly so and tastes much like common alum.

APLANATIC LENSES, a term applied to lenses nearly or quite free from spherical aberration. If the curved surfaces of a single convex lens are portions of spheres, the rays of light from one point of an object are not accurately brought together at one corresponding point of the image, the rays passing through the outer portions of the lens being too much refracted. The result is a distorted image. Theoretically it is easy to correct this error by substituting ellipsoidal surfaces for the spherical, but such surfaces cannot be accurately constructed. Spherical aberration is corrected, in practice, by combinations of two or more lenses in one, the surfaces being of differing curvatures. The results are quite satisfactory, and the method is applied in the manufacture of objectives and eye-pieces for telescopes and microscopes, as well as in the making of lenses to be used in photography.

APOCALYPSE (Greek, *apokalypsis*, from *apokalyptō*, I reveal), the name frequently given to the last book of the New Testament. It is generally believed that the Apocalypse was written by John in his old age, at the end of the 1st century (95–97 A.D.), in the Isle of Patmos, whither he had been banished by the Roman Emperor Domitian. Though commonly regarded as genuine in the first centuries of Christianity, critics have not been wanting who have doubted the evidence of its being the work of Saint John. Its genuineness was maintained by Justin Martyr (c. 150), Irenæus (195), Clement of Alexandria (200), Tertullian (207), and many others; and doubted by Dionysius of Alexandria (240), Cyril of Jerusalem, Chrysostom, and nearer our own times, by Luther and a majority of eminent German commentators. In recent times a composite authorship has been suggested and some have regarded it as a Jewish work adapted by a Christian writer. The Apocalypse, on account of its metaphorical language, has been explained differently by almost every interpreter, and for the same reason it has furnished all sorts of sects and fanatics with quotations to support their creeds or pretensions. There can be no doubt that the hopes of the early Christians and the severe persecution they endured led them to regard the Roman empire as the object of prophetic denunciation, and the coming of Christ and the millennium as near at hand. When, under Constantine, however, the Christians became dominant and prosperous, the empire was considered as the scene of a millennial development, and in course of time the barbarous hordes who were closing round Rome were regarded as fulfilling the woes predicted in the Apocalypse. At the Reformation the Protestants identified Babylon with papal Rome, and the second beast of Antichrist with a universal pontiff. The modern interpreters may be divided into three schools: namely, the historical school, who hold that the prophecy embraces the whole history of the Church and its foes from the time of its writing to the end of the world; the Præterists, who hold that the whole, or nearly the whole, of the prophecy has been already fulfilled, and that it refers chiefly to the triumph of Christianity over Paganism and Judaism; and the Futurists, who throw the whole prophecy, except the first three chapters, forward upon a time not yet reached by the Church — a period of no very long duration, which is immediately to precede Christ's second coming. The Apocalypse contains 22 chapters, which may be divided into two principal parts. The first comprises "the things which are" — that is, the then present state of the Christian Church, including the epistolary instructions and admonitions to the angels or bishops of the seven churches of Ephesus, Smyrna, Pergamos, Thyatira, Sardis, Philadelphia and Laodicea, situated in Asia Minor. The second part comprehends a prediction of "the things which shall be hereafter," referring either to the future state of the Church through succeeding ages, from the time of the apostle to the grand consummation of all things, or to the state of the souls of men after the general resurrection. SEE APOCALYPTIC LITERATURE.

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APOCALYPTIC LITERATURE. A distinct type of religious literature emanating from Jewish and Christian sources. The formative period of its growth and development reached from 200 B.C. to 100 A.D. The name "Apocalypse" comes from the Greek, meaning "disclosure" or "revelation," and refers to a special kind of literature. The occasion for the appearance of this particular kind of literature among the Jews was the Maccabean revolt and the attendant causes leading up to the revolt. The rebellion itself was no more or less than a severe reaction against Hellenism and the threatened domination of Jewish thought and life. It was the clash of two nationalities and two religions that were almost mutually exclusive. It was in the heat of this period of strife that this literature found its voice and its mission, and by means of its encouragements became veritable "tracts for bad times."

Origin.— The origin of the apocalyptic literature has been the source of much discussion during the past few years. Almost every branch of Jewish society has been accredited with its production. Some authorities contend that it must have come from the Essenes, others from Persian sources, and still others from Hellenistic sources. The best conclusion seems to be that the literature is first of all distinctly Jewish and Palestinian in origin, and that it emanated from the lay classes instead of the recognized official classes. This condition easily accounts for its Pharisaical teachings, its demonology so often accredited wholly to Persian sources and its traces of Hellenism. The place of writing is still a matter of conjecture, but there is much to favor the idea that it was written (that is, the most of it) in Galilee.

Characteristics and Problems.— The outstanding characteristics of the apocalyptic literature are three in number. The most significant one is the characteristic of pseudonymity. Some have concluded that this is the only mark of an apocalypse, and as a consequence much confusion has arisen in the use of the modern term "pseudepigrapha." The typical apocalypse is written under the assumed name of some ancient worthy and purports to come from his time. The use of the name in this way is regularly followed out in all apocalypses down to the 14th century A.D., with a few exceptions in the New Testament. The real reason for this assumption of another name, as the medium of revelation, is to be found in the crystallization of the idea of a sacred canon of Scripture. To writers of the apocalypses the canon was practically closed, the time of revelation had passed, and so in order to reach the people with a new message the Patriarchs, Enoch, Moses and Daniel are made expositors of elaborate revelations. Another marked characteristic of the apocalyptic literature is the use of symbolical language, visions and imagery. The visions are elaborate and rendered somewhat mysterious in their use of symbolical language. The "horn" of an animal generally represents a king. The "little horn" of Daniel represents Antiochus Epiphanes. The patriarchs are represented as "white bulls." The righteous Israelites are "sheep" or "lambs." Foreign nations are pictured as ravenous beasts. Further the legalistic emphasis of the apocalyptic is very noteworthy. In every case, with the exception of 4 Ezra, allegiance to the Law or the Torah is affirmed or assumed. In some cases the validity of the Law is recognized, even as last authority. Hand in hand with this recognition of the Law is the general expressed loyality to the Temple and its worship.

One of the greatest problems of apocalyptic literature is its relation to Old Testament prophecy. The similarities between the two forms of literature are marked. In the face of much discredit that has been thrown upon the apocalyptic writers, it must be said that they were the best successors of the great prophets, both in spirit and deed. They have the same basis of revelation and inspiration. Both possess an eschatology and are highly ethical. On the other hand the differences are very striking. Old Testament prophecy is always conditional in regard to future events; but in the case of the apocalyptic, the conditions are of minor importance, as the prediction will come to pass in a mechanical way irrespective of human conduct. The most striking difference is found in the scope of the two eschatologies. In Old Testament prophecy eschatology is almost entirely concerned with the nation, but in the apocalyptic the eschatology of the individual is highly developed. A firm belief in the future life is one of the cardinal doctrines of the apocalyptic. Again the belief in a new heaven and a new earth is one of the finest products of this literature.

The most representative apocalypses come from the period 200 B.C. to 100 A.D. It must not be concluded that the apocalyptic sprang into being at one time. The transition toward the apocalyptic was made in the Old Testament itself, as shown by the appearances of the apocalyptic tendencies in Ezekiel and Isaiah 24–27, and one of the best apocalypses, the book of Daniel. The principal Jewish apocalypses of the period 200 B.C. to 100 A.D. are, arranged in chronological order, Enoch, Testaments of the Twelve Patriarchs, Assumption of Moses, Secrets of Enoch, 2 Baruch, 3 Baruch and 4 Ezra (2 Esdras). A general survey of the character and contents of these books is as follows:

Enoch.— It is a composite collection of writings coming from different centuries. There are indications of at least five books, so that a more appropriate title would be the "Books of Enoch." The oldest sections of this Enoch literature are in chapters 83–90 and 1–36. These

chapters date from the first half of the 2d century B.C. Chapters 83–90 are the oldest sections of the book, and by far the most complete and typical of the apocalyptic. They consist of dream visions from the beginning to the end of time. History is allegorized by use of symbolical language. Chapters 1–36 narrate the visions of Enoch and his journeys through earth, Sheol and heavenly places. This has been truly named the work of a "Jewish Dante." The 1st century B.C. sections are chapters 37–71 and 91–108. Chapters 37–71 have been named the "Parables of Enoch," and they picture the judgment of the wicked, the lot of the apostates, the blessedness of the saints and the idea of a new heaven and a new earth. Chapters 91–108 are a series of exhortations. Chapters 72–82 are a little uncertain in regard to the date, but they probably come from the 2d century B.C.

The Testaments of the Twelve Patriarchs. — It is a series of apocalyptic writings in the name of the 12 sons of Jacob. The entire set of writings, with the exception of a few later Jewish and Christian interpolations, comes from the latter part of the 2d century B.C. The Testament of each Patriarch in turn follows the same literary form of division into a triple arrangement. The first division of each one is a historical sketch based upon Genesis. Some particular vice or virtue is emphasized. In the second division an exhortation is given relative to these vices or virtues. The third division deals with the future of the family and in predictive ways outlines future events. The book as a whole marks the high-water mark of Jewish ethics in this early period.

Assumption of Moses.— It was written in Palestine during the first part of the 1st century A.D. The interest in this apocalypse dates from the discovery of a Latin manuscript in Milan in 1861. By means of this Latin fragment, the Greek fragments and the New Testament allusions in Jude and 2 Peter, the restoration of some of the details of the original is about complete. The author evidently was a man with Pharisaic beliefs. The chief value of the book is its close relation to the New Testament writings.

Secrets of Enoch.— The apocalypse is sometimes called 2 Enoch. The text has been largely recovered from the Slavonic versions of the 16th and 17th centuries. It was written by a Hellenistic Jew, probably in Egypt, during the middle of the 1st century A.D. One of the prominent marks of its Hellenistic tendencies is its doctrine of the pre-existence of man.

2 Baruch.— This apocalypse is often called the Syriac Apocalypse of Baruch, because of the discovery of a very fine copy of it in the Syriac language. This manuscript was a translation from an original manuscript in the Greek and was discovered in 1866. The book is composite in origin, parts of it being written as early as 50 B.C. and other parts of it coming from after the fall of Jerusalem in 70 A.D. The outlook, as far as the future is concerned, in the earlier sections is very hopeful, while in the later sections all hope for a messianic kingdom is practically abandoned. The greatest value of the book is its inter-relation to the Epistles of Paul.

3 Baruch.— It is called the Greek Apocalypse of Baruch. It was not definitely recognized as a separate book from the other books of Baruch until the discovery of a manuscript in 1896. It was written in the days of the early Christian Church in the 1st century A.D. It refers to only five heavens, while Enoch refers to seven and Secrets of Enoch to ten.

4 Ezra.— Chapters 3–14 of 2 Esdras of the Old Testament Apocrypha are the apocalypse of 4 Ezra. This order of the different books of Ezra is derived from the Vulgate. It is not a unit; some parts were written before the fall of Jerusalem in 70 A.D., and some were written as late as 120 A.D. The main section of the book is found in chapters 3–10, generally designated as the Salathiel Apocalypse. The remaining sections consist of several significant visions. The main value of the book lies in its relation to the problems of pre-Talmudic days and the New Testament.

In addition to these more important Jewish apocalypses there are numerous Christian apocalypses. Some are found in the New Testament, as, for example, the book of Revelation. The most important ones outside of the New Testament are the Apocalypse of Peter, the Testament of Hezekiah, Shepherd of Hermas and numerous Christian Sibylline Oracles. Some of the Sibylline Oracles have a few ancient Jewish elements in them coming from the 2d century B.C. The New Testament apocalypses are not written under assumed names, which can largely be accounted for by the new emphasis upon personality in Christianity. However, closely following the period of the New Testament the literary form of pseudonymity is again assumed. See APOCRYPHA.

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APOCALYPTIC NUMBER, the mystic number 666, which, according to some authorities, should be 616, mentioned in Revelation xiii, 18. As early as the 2d century ecclesiastical writers found that the name Antichrist was indicated by the Greek characters expressive of this number, numbers being expressed in Greek by the letters of the alphabet. By Irenæus the word *Lateinos* was found in the letters of the number, and the Roman empire was therefore considered to be Antichrist. Another solution is *Neron Kesar* (Hebrew form of Nero Cæsar). Omitting the *e's* and the *a*, not written in ancient Hebrew, we get 666 as the value of the letters.

APOCRYPHA. The term "Apocrypha" is generally applied to distinct groups of religious literature closely associated with the canons of the Old and New Testaments. This literature was not regarded as canonical, although much

read and quoted in church and synagogue. The Old Testament group, a collection of 14 books of Jewish origin, is found in the Greek and Latin versions, but not in the Hebrew versions. The New Testament group is rather an indefinite body of early Christian literature consisting of parallels and additions to the writings of the New Testament.

The use of the term «Apocrypha» and «Apocryphal» varies to great extent, especially among Protestants and Roman Catholics. The authorities of a Protestant persuasion apply the term Apocrypha to the two groups known as the Old and the New Testament Apocrypha proper. However, the term Apocryphal is made not only to include these two groups, but also many of the Jewish pseudoepigraphic writings. The Catholics designate the books of the Old Testament Apocrypha proper as Deuetro-Canonical books (except 1 and 2 Esdras and the Prayer of Manasses), and group all the remaining Jewish and Christian literature of a kindred origin under the term Apocryphal.

The meaning of the term Apocrypha (coming from the Greek word meaning «hidden») has undergone several very significant changes in the course of its use and application. Historically considered three principal changes in the meaning of the word should be noted. In its earliest use it was restricted to the writings of more or less sacred character, but containing certain mysterious and esoteric teachings intended only for the wise and the initiated (2 Esdras xiv, 45f). In this case there was no discredit thrown upon the writings, because of authorship or contents. Still another meaning was given to the term by some of the Church Fathers, especially Origen, wherein it was applied to all writings of a secondary or questionable character. Many of the works thus branded were discredited as to their teachings and withdrawn from public use. Finally the term was used to designate false and heretical literature.

In addition to this general uncertainty much confusion has prevailed in regard to the value of the literature. Some of these differences can be traced back to the different ideas of canonicity as held in Jewish and Hellenistic circles. Some of the Church leaders, especially in the Western Church, ascribed full scriptural authority and inspiration to the apocryphal writings. This view finally bore fruit in the Council of Trent in 1546 when 11 of the books of the Old Testament Apocrypha were declared canonical. On the other hand a great number of the leaders, because of their close association with Hebrew traditions, denied scriptural authority and value to any of the books. This view was championed by Jerome and finally found expression in the Protestant-Christian view of Reformation times. There were some who did not accept either one of these two extreme views. They clearly recognized the value of the literature, but at the same time they were not willing to place the books on the same level with the Biblical books. This latter view finally found expression in the teachings of the Church of England.

Old Testament Apocrypha.— The Old Testament Apocrypha proper contains 14 books, and represents, except for a few minor variations, the excess of the Greek canon over the Hebrew canon. The books may be classified in the following way:

1. *Parallels or Additions to the Old Testament.*— The Prayer of Manasses, The Song of the Three Holy Children, The History of Susanna, Bel and the Dragon, The Rest of Esther, 1 Esdras and Baruch (including the Epistle of Jeremiah).

2. *Historical.*— 1 Maccabees and 2 Maccabees.

3. *Legendary.*— Tobit and Judith.

4. *Wisdom Literature.*— Ecclesiasticus and Wisdom of Solomon.

5. *Apocalyptical.*— 2 Esdras (4 Ezra).

A brief survey of these books is as follows:

The Prayer of Manasses.— It is a product of the 1st century B.C., and was intended to be used in connection with the story of Manasseh's Babylonian capacity (2 Chron. xxxiii). Parts of the Prayer have found their way into Protestant liturgy.

The Song of the Three Holy Children.— One of the principal additions to Daniel. It was written about 100 B.C. and was found inserted in the book of Daniel, the third chapter, right after the 23d verse.

The History of Susanna.—Another 1st century B.C. addition to the book of Daniel. It is generally found prefixed to the book. The purpose of the story is to magnify the powers and the judgment of the hero of the book.

Bel and the Dragon.— It was written about 100 B.C. It is the story of Daniel's sagacity in exposing some of the flagrant abuses of idolatry.

The Rest of Esther.— This writing consists of a number of additions to the Biblical book of Esther. The additions were made to add detail and make up for some of the deficiencies of the canonical book. It was written about 100 B.C.

1 *Esdras.*— It is the Greek version of and in some parts a reconstruction of the canonical Ezra. It was written about 100 B.C. Some of additional subject matter is from the book of Nehemiah.

Baruch.— The greater part of this book was written in the 1st century A.D. The book is written under the assumed name of Baruch, the private secretary of Jeremiah. The 6th chapter is known as the Epistle of Jeremiah. Both books contain a series of exhortations and encouragements and severe denunciations of idolatry.

1 *Maccabees.*— It is one of the best sources on the period from 175 to 135 B.C. It treats of the causes of the Maccabean rebellion and the rebellion itself down to the death of Simon in 135 B.C. It was written by a Jew in Palestine during the latter part of the 2d century B.C.

2 *Maccabees.*— It is a mixture of history and fiction. It is an abridgment of a much larger work in existence at the time of its writing in latter part of the 2d century B.C. It treats of the period leading up to the rebellion of the Maccabees under Mattathias in Modein, and the rulership of Judas down to 161 B.C.

Tobit.— It is a popular story of romance and legend from the Jewish Dispersion in Egypt. The story was written in the 3d century B.C., and was based upon the well-known Egyptian stories of 'The Fable of the Ungrateful Dead' and 'The Tractate of Khons.' The purpose of the story was to teach some useful lessons,

and at the same time to correct some of the current superstitions.

Judith.— It is a legendary story of a Jewish widow who succeeded in outwitting and finally slaying a great Assyrian general, thus bringing deliverance to her oppressed people. It was written in Palestine during the latter half of the 2d century B.C., probably by a Pharisee.

Ecclesiasticus.— It is a book of proverbs and practical observations on life closely resembling the Wisdom Literature of the Old Testament. It was written about 180 B.C., and forms one of the most valuable records of early Rabbinical thought. It was translated into Greek in 132 B.C. by a grandson of the author (Jesus ben Sira).

Wisdom of Solomon.— In some respects it is one of the most valuable of the books of the Apocrypha. It was written by a Jew of the Dispersion about 65 B.C. It is similar to the Wisdom Books of the Old Testament. It was written with the distinct purpose to combat the materialistic tendencies of the canonical book of Ecclesiastes.

2 Esdras.— It is an apocalypse, especially chapters 3–14. It is composite in origin, dating from 65 B.C. to 120 A.D. The book is especially valuable, as it bears on the period of Jewish thought in relation to the fall of Jerusalem in 70 A.D. Its views on eschatology are closely allied to the teachings of the New Testament.

There are several books worthy of note belonging to the general class of Jewish apocryphal literature but still outside of the Apocrypha proper of the Old Testament. The most noteworthy books of this class are the books of Jubilees, 3 Maccabees, 4 Maccabees, Psalms of Solomon and the Martyrdom of Isaiah. See APOCALYPTIC LITERATURE.

Jubilees.— It has been called the "Little Genesis," as it represents the book of Genesis rewritten from the standpoint of the Law or legalistic Pharisaism. It was written during the latter half of the 2d century B.C. by a Pharisee. Religious institutions and concepts of the 2d century are read back into the days of the patriarchs.

3 Maccabees.— It is a religious novel coming from Hellenistic Judaism in the 1st century B.C. Its central theme is the marvelous deliverance of the Jews from Egyptian persecution by divine intervention.

4 Maccabees.— It belongs to the great body of Jewish Wisdom literature, coming from Hellenistic centres. It attempts to discuss in treatise form the power of inspired reason over the passions. It was written during the 1st century A.D.

Psalms of Solomon.—A collection of Psalms resembling the Hebrew Psalter. They were written about 50 B.C. by Pharisees.

Martyrdom of Isaiah.— It is a product of the 1st century A.D. It records the tradition of the death of Isaiah at the hands of Manasseh, King of Judah.

New Testament Apocrypha.— The general character of the books of the New Testament Apocrypha is quite different from that of the Old Testament Apocrypha. In the first place the books of the New Testament group form somewhat of an indefinite body of literature, as new ones are being discovered from time to time. The majority of the writings come from the 2d century A.D. and represent all shades of religious belief. Further the literature differs from the Old Testament group, in that there is a deliberate attempt to fill in the gaps in the New Testament narratives, and in some cases even to supersede the earlier ones. For the most part they are writings filled with tradition, fiction and the description of the marvelous. Many of the ecclesiastical dogmas of the Middle Ages can be traced to this fruitful source.

The books of the New Testament Apocrypha can be arranged under three heads, namely: Gospels, Acts, and Epistles. A few of the more important under each group will be mentioned:

GOSPELS. *The Gospel according to the Egyptians.*— It reflects a severe belief in asceticism and agnosticism. *Gospel according to the Hebrews.*— It was written by some of the followers of the Nazarenes and the Ebionites. *Gospel according to Peter.*—It was discovered in 1885 and published in 1892. It was popular among the Syrian Christians. *Gospel according to Thomas.*— It is an attempt to fill in the story of Jesus' infancy. Jesus is described as a miracle worker from the beginning.

ACTS. The most important one in this class is the *Acts of Paul and Theba.* It is a romantic story of a woman converted under Paul's ministry. In addition to this writing there are the *Acts of Andrew, John* and *Peter.*

EPISTLES. *The Epistle of Abgar.*—It contains the message of Abgar, the King of Edessa, to Jesus and his answer. *Epistle of Barnabas.*—An important Epistle of 21 chapters teaching the dangers of relapsing into Judaism. *Epistle of Clement.*— It seeks to bring and to restore harmony into the Church at Corinth.

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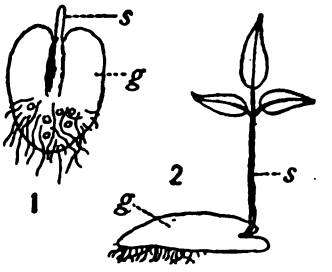
APOCYNACEÆ, the designation of an extensive natural order of monopetalous exogenous plants, characterized by perfectly symmetrical flowers, the segments of the corolla all twisted one way like a catherine-wheel, five distinct stamens, a superior ovarium, which when ripening opens into two parts that diverge from each other at right angles; fruit follicular or capsular, or drupaceous or baccate, double or single. The order consists of trees or shrubs, many of whose stems yield, when wounded, a copious milk, usually poisonous. Generally found in tropical regions, they appear to be most abundant in the hot parts of Asia, are less common in the tropics of America, and still more rare in Africa. About 100 genera, including 566 species, have been enumerated. The plants of this order are in many cases poisonous, and very generally to be suspected, although in some cases they are used medicinally, and in others have an edible fruit. One of the most deadly plants of the order is the *Tanghina venenata.* The kernel of the fruit, although not larger than an almond, is sufficient to kill 20 men; it was formerly used in Madagascar as an ordeal. The common oleander (*Nerium oleander*) is a formidable poison and death has resulted from eating its flowers.

APODICTIC JUDGMENTS, a logical term adopted by Kant from Aristotle to distinguish judgments or conclusions which are beyond contradiction from those which are merely empirical; or to put it differently, a judgment or conclusion which is founded on the impossibility of the opposite, not upon grounds of experience, is an apodictic judgment.

APOGAMY. In all plants which have reached the level of sexuality, a new individual is initiated by the union of two cells, called *gametes.* In exceptional cases the ability to reproduce sexually is lost, either temporarily or permanently. Plants which have lost this power, after having attained it, are said to be apogamous and the condition is apogamy, the word meaning that the union of gametes has been left out. The new individual may be developed from any part of the gametophyte, or



gamete-bearing plant. When the new individual arises from an egg, without fertilization, this kind of apogamy is called *Parthenogenesis* (q.v.). When the new individual arises from any other part of the gametophyte except the egg, some prefer to call the phenomenon vegetative apogamy. A familiar case of vegetative apogamy is found in some common ferns, especially in highly cultivated greenhouse varieties. The beautiful fern, *Nephrodium molle,* which can be found in almost any greenhouse, is the most thoroughly investigated illustration. The prothallium, or gametophyte (see ALTERNATION OF GENERATIONS) becomes thickened along its median portion, making it look like a very small prostrate leaf with a midrib. This thickened region grows out beyond the border of the prothallium, curves upward, then becomes entirely erect and develops leaves, stem and roots. This plant, in every way, looks just like one arising from a fertilized egg. The essential feature of the phenomenon is the transition from the gametophyte to the sporophyte generation without any fusion of gametes. The thickened rib-like region of the prothallium, viewed from the under side, is shown in Fig. 1, *s.* A later stage, after the young apogamous sporophyte has developed leaves, is shown in Fig. 2, in which *g* is the gametophyte and *s* the sporophyte. Vegetative apogamy has not been found in Thallophytes, liverworts, mosses, lycopods or equisetums; but a score of cases have been reported in the true ferns and water ferns. No case has been established in Gymnosperms. In the Angiosperms several cases are well known. In the common onion (*Allium Cepa*), embryos have been found developing from the antipodal cells and from synergids. (See ALTERNATION OF GENERATIONS). In the fern (*Nephrodium molle*) the number of chromosomes in the nuclei of the new sporophyte is the same as the number of nuclei of the gametophyte. In the flowering plants the gametophyte which gives rise to the apogamous embryo has the sporophyte, or 2x, number of chromosomes. Some persist in using the phenomenon of apogamy as an argument for or against certain theories of alternation of generations; but in our opinion, apogamy is a secondary, highly specialized condition which has no bearing upon the subject.

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APOGEOTROPISM, the form of sensitiveness to gravity in plants evidenced by the universal tendency to grow vertically upward, in a direction opposite to that of the earth's attraction. When centrifugal force is brought to bear upon the plant in place of gravity the stems grow toward the centre of revolution while the roots grow in the opposite direction.

APOLLINARIANS, a sect of Christians who maintained the doctrine that the Logos (the Word) holds in Christ the place of the rational soul, and consequently that God was united in him with the human body and the sensitive soul. Apollinaris, the author of this opinion, was, from 362 A.D. till about 382 A.D., bishop of Laodicea, in Syria, and a zealous opposer of the Aryans. As a man and a scholar he was highly esteemed, and was among the most popular authors of his time. He formed a congregation of his adherents at Antioch, and made Vitalis their bishop. His teaching was condemned at Alexandria in 362; by Pope

Damasus in 375; and in the Council of Constantinople in 381. The Apollinarians, or Vitalians, as their followers were called, soon spread their sentiments in Syria and the neighboring countries, established several societies, with their own bishops, and one even in Constantinople. The sect was denounced in 428 by imperial edict, and its members gradually returned to the Church or became Monophysites (q.v.). Consult Harnack, 'History of Dogma.'

APOLLO, son of Zeus (Jupiter) and Leto (Latona), who being persecuted by the jealousy of Hera (Juno), after tedious wanderings and nine days' labor, was delivered of him and his twin sister, Artemis (Diana), on the island of Delos. He was the most important of the Olympian deities after Zeus and appears in mythology as the god of poetry, music and prophecy, the patron of physicians and shepherds and the founder of cities. He aided Zeus in the war with the Titans and the giants, and destroyed the Cyclopes because they forged the thunder-bolts with which Zeus killed his son and favorite Asklepios (Æsculapius). All of the male sex dying suddenly without previous sickness were supposed to be smitten by the arrows of Apollo. In the oldest poems Apollo is exhibited as the god of song, being known in this function as Apollo Citharœdus. Two statues of Apollo Citharœdus are extant, one of them at the Glyptothek in Munich, the other at the Vatican, but their date is unknown. In the festivals of the gods and those of men in which they took part he plays and sings while the Muses dance around him. According to some traditions he invented the lyre, though this is generally ascribed to Hermes (Mercury). Marsyas, who ventured to contend with him on the flute, was conquered and flayed alive by the god. Apollo had another contest with Pan, in which the former played on the lyre, the latter on the pipe. Tmolus had already decided in favor of Apollo, when Midas, opposing the sentence, was decorated with a pair of ass's ears for his stupidity. That Apollo had the gift of prophecy appears from the Iliad, where he is said to have bestowed it upon Calchas and Cassandra; and in the Odyssey mention is made of an oracular response delivered by him in Delphi. The oracle at this place became very famous. He also revealed future events at Abæ in Phocis, Didyma near Miletus, Claros near Colophon in Ionia, Tenedos and Patara in Lycia. Apollo, in later times, came to be regarded as the god of physic, and was represented to be the father of Asklepios, the god of healing. He is reported to have taken charge for a long time of the herds of Admetus, according to some authorities voluntarily, according to others compelled by Zeus, on account of the murder of the Cyclopes, or the serpent Python. As a builder of cities, the founding of Cyzicum, Cyrene and Naxos in Sicily is ascribed to him, while Homer relates that he built the walls of Troy together with Poseidon (Neptune), and afflicted the city afterward with a pestilence, because Laomedon defrauded him of his pay. According to the poets and sculptors, Apollo, with Ares (Mars), Hermes (Mercury) and Dionysos (Bacchus), belongs to the beardless gods, in whom the dawnings of early manhood appear. He is figured with a bow, a quiver and plectrum, a serpent, a shepherd's crook, a griffin and a swan, a tripod, a laurel, an olive-tree, etc. He was originally the sun-god and though in Homer he appears distinct from Helios (the sun) yet his real nature is hinted at even here by the epithet Phœbus, the radiant or beaming. In later times the view was almost universal that Apollo and Helios were identical and by this theory of his origin we can easily understand how he should be regarded as the god of pastures (Nomios) and of flocks (Karneios), the god that protects and causes the fruits of the field to grow, the god that gives fair winds to mariners (Embasios), etc. As he slew the Python, that is, the hostile powers of darkness, with his arrows (the sunbeams), so in later times he was looked on as the averter of evil, the bringer of help and the punisher of overweening pride (as in the story of Niobe). From being the god of light and purity in a physical sense he gradually, as he became endowed more and more in the Greek mind with an ethical character, became the god of moral and spiritual light and purity, the source of all intellectual, social and political progress. Thus he came to be considered as the god of song and prophecy, the god that purifies after the commission of crimes, that averts and heals bodily suffering and disease, the institutor and guardian of civil and political order and the founder of cities. Though not one of the original gods of the Romans, his worship was introduced at Rome at an early period, probably in the time of the Tarquins. Among the ancient statues of Apollo that are extant the most remarkable, and in the judgment of the learned and acute Winckelmann the best and most perfect that art has produced, is the one called the Apollo Belvedere, from the Belvedere Gallery in the Vatican at Rome; also called the Pythian Apollo, because it is supposed that the artist has represented the god in the moment of his victory over the serpent Python. This statue was found in the ruins of Antium in 1503. It is conjectured to be a careful copy of a Greek original, perhaps of the 4th century B.C., or possibly a century or more later.

APOLLO, Pa., borough of Armstrong County, 25 miles northeast of Pittsburgh, on the Kiskiminetas River and the Pennsylvania Railroad. It has manufactories of lime, steel and woolens, and a large trade in coal, which is mined extensively in the district. Apollo was first settled about 1790, was laid out in 1816 and became a borough in 1848. Pop. 3,006.

APOLLO BELVEDERE, bĕl'vā-dā'rā. See APOLLO.

APOLLODORUS. (1) An Athenian painter of the 5th century B.C. He is credited with the introduction of rendering light and shade instead of flat coloring. (2) A Greek grammarian of the 2d century B.C. He studied philosophy at Athens and afterward became a follower of Aristarchus at Alexandria. He wrote several grammatical works and a history in iambic verse. His 'On the Gods' was a history of the Greek religion. It is lost and its nature can only be judged from passing references. (3) A famous Roman architect of the 2d century A.D. The Emperor Trajan employed him in the construction of his great

bridge over the Danube, in the building of the Forum, since known as the Forum Trajani, and other works. He censured the architectural plans of Hadrian and was banished from Rome.

APOLLONIUS, Pergæus, from Perga in Pamphylia; lived about 250–200 B.C. He was educated in Alexandria under the successors of Euclid, and became one of the greatest mathematicians of antiquity, being commonly called the "Great Geometer." His most important work was a treatise on conic sections, in eight volumes, of which the first four, with the commentary of Eutocius, are extant in Greek, and all but the eighth volume in Arabic. We have also introductory 'lemmata' to all the eight by Pappus, edited by Halley, 'Apollonius Pergæus Conic,' lib. VIII, c., Oxon. 1710 fol.

APOLLONIUS OF TYANA, Pythagorean philosopher: b. Tyana, in Cappadocia, about whom many wonderful stories are told. He was born in the beginning of the Christian era, early adopted the Pythagorean doctrines, abstaining from animal food and living in the simplest manner, and according to the Pythagorean precept maintained a rigid silence for five years. He traveled in Asia, disseminating his doctrines and doing many wonderful things, and proceeding as far as India, where he became initiated into the doctrines of the Brahmans. When Domitian ascended the throne Apollonius was accused of having excited an insurrection in Egypt in favor of Nerva, but readily submitting to a trial he was acquitted. After this he went once more to Greece and passed over to Ephesus, where he opened a Pythagorean school, and died in 96, or, according to others, 110 A.D.

APOLLOS, an early Christian missionary and companion of Saint Paul. He was born at Alexandria, where he was converted to the new faith by disciples of John the Baptist. He at once became an earnest and zealous propagator of Christianity. He came to Ephesus, where he received further instruction from Aquila and Priscilla, and next proceeded to Corinth, where he labored with great success. He returned to Ephesus, but his followers recalled him to Corinth. He is last mentioned in the New Testament as about to start for Crete. Tradition has it that he became first bishop of Crete. Consult Acts xviii, 24–28; 1 Cor. i, 10–12; iii, 4–6; xvi, 12; and Titus iii, 13.

APOLLYON, ă-pŏl'lĭ'ŏn, or ă-pŏl'yŭn, a rendering of the Hebrew Abaddon, meaning destruction. Apollyon is personified as the keeper of the bottomless pit.

APOLOGETICS, the department of theological science which deals with the defense of the Christian faith. It differs from dogmatics which strives to reduce the doctrines of religion to a systematic form; and from polemics, which is the science of controversy, and while its subject matter comprises the differences found in different schools of believers, apologetics deals with attacks upon the faith which are made by unbelievers. Apologetics may be again distinguished from apologies. The former has to do with the fundamental principles of the religion and with the methods of defense which apply to all attacks, but an apology has to do with some special form of unbelief. The former is the science of which the latter is an application. Yet, apologetics as a science may be best understood through its historical applications and the distinction named is made more readily in theory than exhibited in detail.

Owing to the nature of Christian theology as historically formulated, apologies have fallen under two main divisions, popularly known as natural theology and the evidences of Christianity. The former is usually put before the latter. It discusses the nature of God and the proofs of His existence as revealed to us in nature. It may also investigate the nature of man, his moral sense, the freedom of his will and his capacity for knowing God. Its chief reliance has been upon four arguments: the ontological, which starts from our idea of a perfect being and shows that it implies actual existence; the cosmological, which from the long line of causes and effects, each contingent, argues backward to a first great cause, which is itself uncaused; the teleological, which shows the marks of design in nature, and from them argues to a great designer; the moral, which starts with the moral sense in man and argues to a holy and righteous maker. Some writers add an æsthetic argument, from our sense of beauty and its gratification in the universe. Then these various arguments are combined and the perfect being is shown to be the first great cause, righteous, wise and a person whom therefore we call God.

The evidences of Christianity assume the existence of such a God, and from this basis prove Christianity to be His peculiar revelation, constituting the absolute religion. This proof ordinarily is divided into two great divisions, external and internal. The external proofs are miracles and completed prophecy, which evince a power and wisdom which are Divine and guarantee the Divine authorship of the writings which they authenticate. The external proofs include also the historical evidence to the genuineness of the scripture writings. The internal evidences show the adaptation of the contents of the Bible to the needs of men, their agreement with the highest teachings of reason, and their elevating and purifying effect upon the mind and life. A further argument is based upon the experience of the Christian as testifying to the truth of the doctrines involved.

This argument in both divisions, natural theology and the evidences of Christianity, occupies the chief place in the textbooks, but, evidently, it is a form of specific apology and at best only in part illustrates essential apologetics. This it appears from a wider survey for the argument as stated above, while it meets a special situation, neither represents the actual argumentation in the first ages of the Church nor in our own day. Even in the New Testament some of the writings have an apologetic purpose. Christianity in its early form met two opponents, Judaism and heathenism. To the first, the apostolic writers attempted to prove its truth by showing it as foretold in the Old Testament, and as completing the earlier Scriptures. When Christianity encountered Greek thought the situation was wholly different, and the apologists formulated the contents of the gospel in a manner which appealed to the common sense of all the serious thinkers and intelligent men of the age. That is, Chris-

tianity was presented as completing, or at least harmonizing with, the later Greek philosophy. In this it succeeded and then ensued a long period when apologetics was in abeyance. The intellectual life of the Church was engaged in formulating dogmas and in conflicts with heresy. Only long after the Reformation was the strife renewed with men who seriously denied the truth of Christianity.

In the end of the 17th century and the beginning of the 18th century the minds of English Churchmen were engaged by the Deistic controversy. This had to do with the evidences of Christianity. The Copernican astronomy, changing men's conceptions of the physical universe, the discovery of China, or better its rediscovery and its effect upon the imagination of thoughtful men, and the attacks of the British clergy upon the miracles of the Roman Catholic Church, brought on a crisis. The new astronomy suggested the thought that the God of so great a universe could not be identical with Jehovah, the God of a Semitic people; nor could men conceive of the earth, no longer central but a mere planet, as the scene of the drama of the incarnation and the redemption; the consideration of China with the thought of its relatively high civilization suggested that if China had got on so well without the special teaching of the gospel with the light of reason only, the special revelation must also be valueless to Englishmen; and the attacks of the clergy upon the Roman Catholic miracles as the frauds of priests led to the position that all miracles, including those of the Bible, may be put into the same category. It was further urged that the description of Jehovah in the Bible and in the doctrines of the Church does not accord with the righteousness and wisdom and power of the God disclosed by nature. The conception of nature as a vast machine was taking possession of men's minds, and God was thought to be the maker and starter of the machine, and as having no further occasion to interfere with its running. He was not denied, therefore, but He was made infinitely remote, and there seemed no opportunity for miracle, redemption or prayer. The attack called forth a multitude of replies, the 'Analogy' of Bishop Butler being the most effective and distinguished. He argued that revealed and natural religion are not opposed, but that the second supplements the first, and that its peculiarities are what we should expect from a study of nature itself; and that further, the difficulties urged by the Deists against the God of the Bible lie with equal force against their own teaching of the God of nature. It was further argued in particular, that the account of the gospel miracles is to be accepted, because the witnesses were competent, and moreover had everything to lose and nothing to gain by their invention, proving their sincerity by dying as martyrs. The Wesleyan revivals were perhaps more influential than the arguments of the apologists by supplying the powerful evidence of the effectual working of Christianity in the hearts and lives of men. From England the controversy was carried to France, and to Germany, with phases too varied for even the briefest review here.

In the 19th century, from the middle decades on, the apologetic warfare was renewed, with issues far more fundamental. Already Hume had stated positions which threatened the beliefs of Churchmen and of Deists alike, and under the influence of an extreme empiricism, reinforced by influences from German philosophy, men denied that God could be known at all. Hence apologetics again busied itself with the first division of topics, and discussed man's capacity for knowing the Infinite, and reviewed all the evidences for God's existence in the light of the modern science of knowledge. The progressive establishment of the scientific conception of the universe also revived the discussion as to miracles and forced a renewed examination of the whole subject. In addition the historic credibility of the gospel narrative and the authenticity of the Biblical writings have been re-examined from many points of view, while the discovery of the ancient religions of the past and of the living religions of Asia have caused prolonged debate as to the uniqueness and the absoluteness of the Christian teachings. Hence, the apologist is engaged in a discussion which involves philosophy, science, history, comparative theology and criticism.

In general, we may put apologists at present into three classes: those who hold substantially the old positions and seek in part by compromise and in part by adaptation to show that their essential truth may be maintained notwithstanding the progress in philosophy and science; those who abandon the old arguments, and overcome the conflict between science and philosophy on the one hand and theology on the other, by adopting wholly the modern views and reconstructing theology by their aid; and those who attempt to discriminate between religion and science and philosophy, and by penetrating more completely into its essence to find an independent basis for the religious life which shall abide however men's views may change in these other departments. Particular arguments in reply to special attacks are of less moment than a discussion of the meaning and essence of Christianity itself, and of the principles which underlie all defenses of its truth. That is, this age needs not so much an apology or defense of Christian truths as a thoroughgoing study of the science of apologetics itself.

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APOLOGIA PRO VITA SUA (first published in parts, April to June 1864; revised and republished as a whole, 1865), by Cardinal Newman, is the autobiography of a great soul. In 1845 Newman left the English for the Roman Church. Almost 20 years later Charles Kingsley included him in an incidental aspersion (*Macmillan's Magazine*, January

1864) of the Roman clergy's attitude toward "truth for its own sake." The following interchange of letters, pamphlets and articles convinced Newman of the necessity of reviewing, for an end larger than the defense of his own integrity, the whole course of his spiritual progress. This larger aim, suggested in a title that Newman can hardly have chosen without thinking of the great 'Apologia' of Socrates, gives his work a deep general interest. The debate between the two English men of letters went so unquestionably to Newman that it could hardly arouse posterity; the actual immediate issues between the two churches were too clouded by prejudice and politics to hold attention long in that form; but beneath the controversy lay an issue that remains vital; and beneath the history set forth in the book moves an eternal human quest.

The issue was the catholicity of the Church of England. To restore to the Church in which they were priests a general consciousness of Catholic heritage, a wider view of Catholic doctrine and history, and a wider use of the sacraments was the mission of the young Newman and his friends, Keble, Pusey, and others less well known, in what came to be known as the Oxford Movement (q.v.). Working as scholars and as preachers toward this common end in various ways, they made their most direct and effective appeal in a series of 'Tracts for the Times'; and their ultimate success amounted to a reformation. That the Church of England rose from insular prejudices and political bondage to become a great national Church was due largely and directly to the Oxford Movement. The Catholic heritage had, indeed, been cherished and followed even in the 18th century in spite of the general depression of the Church by rationalism and politics. It had animated, for instance, those missions to the New England colonies which moved and brought about the Episcopal Church of the United States. The consecration of the first bishop of that Church was attested in a proclamation "*Omnibus ubique Catholicis.*" But that consecration was by "non-juring" bishops in Scotland. The actual ecclesiastical administration in England then and in Newman's time insisted, if not on a narrower view, at least on a narrower practice. The bishops generally, the dominant ecclesiastical party, and the religious habits of the mass of Church people were far narrower than the doctrine of the Book of Common Prayer or the interpretation of the Caroline divines. The mission of Newman and his friends was restoration. It succeeded ultimately; but meantime it met such ecclesiastical opposition as to drive some of them to the Roman Church. Newman found himself unable to read in the repudiation of some 'Tracts for the Times' and in other ecclesiastical pronouncements and measures of British bishops anything short of a repudiation of catholicity. Becoming convinced that the Church of England was not in fact Catholic, he changed his allegiance.

This is the issue underlying 'Apologia pro Vita Sua'; but vital as it remains, and deeply as it is explored, it has less appeal than the autobiography for itself. The lucidity, sweetness and force spring from aspiration. The steady quest of the soul, set forth with a sincerity that makes one first pity and then forget Charles Kingsley, is told with that high preoccupation which gives to a few autobiographies permanent hold. An accomplished reasoner, Newman understood better than most men the limitations of reasoning in effectiveness on conduct. "It has not pleased God to save His people through logic," he quotes from Saint Ambrose on the title page of the most philosophical of his longer works, 'A Grammar of Assent.' This book inculcates systematically the right ways of the mind seeking truth; but the 'Apologia' by narrating the stages of his own search brings it home. We need not be convinced by his arguments nor subscribe to his conclusions to be uplifted by a noble and single mind following the "kindly light" which he invokes in his famous hymn.

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APOLOGUE, a story or relation of fictitious events intended to convey some useful truth. It differs from a parable in that the latter is drawn from events that pass among mankind whereas the apologue may be founded on supposed actions of brutes or inanimate things. Æsop's fables furnish excellent examples of apologues.

APOLOGY, a term at one time applied to a defense of one who is accused, or of certain doctrines called in question, but at present commonly applied to an acknowledgment of error. The apologies of Socrates attributed to Plato and Xenophon are works of the first-named character. Later rhetoricians wrote upon the use of apologies and caused them to be composed by their scholars. Of this sort are the Apologies of Libanius. Thus the name passed over to Christian authors, who gave the name of apologies to the writings which were designed to defend Christianity against the attacks and accusations of its enemies, particularly the pagan philosophers, and to justify its professors before the emperors. Of this sort were those by Justin Martyr, Athenagoras, Tertullian, Tatian and others. There are also apologies for the doctrines of particular sects; for example, Robert Barclay's 'Apology for the People in Scorn called Quakers.'

APOLOGY FOR THE LIFE OF COLLEY CIBBER, An, an autobiography published in 1740, when the author, poet-laureate, actor and man-about-town was in his 70th year. In the annals of the stage this curious volume holds an important place as throwing light upon dramatic conditions in London after the Restoration, when the theatre began to assume its modern aspect.

APOMECOMETER. An instrument used for measuring heights, constructed in accordance with the principles which govern the sextant, viz.: As the angles of incidence and reflection are always equal, the rays of an object being thrown on the plane of one mirror are from that reflected to the plane of another mirror, thereby making both extremes of the vertical height coincide exactly at the same point on the horizon-glass, so that by measuring the base-line we obtain a result equal to the altitude. The eye of the observer when in position will be at the lower end of the hypothenuse, and the summit of the object at the other. Keeping the line of vision, which

forms the base, exactly horizontal, the observer approaches the object till the images coincide, when the base will agree in length with the perpendicular and the measured length of the former will give the height of the latter.

APOMORPHINE. See MORPHINE.

AP'ONEURO'SIS. See TENDON.

APOPHYLLITE, ă-pŏf'ĭ-līt (from the Greek words *apo,* "off," and *phyllon,* "leaf," in allusion to the tendency of the mineral to separate into thin leaves before the blowpipe), a native hydrated silicate of calcium and potassium, having the general formula $K_2O.8CaO.16SiO_2.16H_2O$, but with some portion of the oxygen replaced by fluorine. It *crystallizes* in the tetragonal system, and also occurs massive. Its crystals are usually white or gray, with a pronounced pearly lustre on the basal plane, and a vitreous lustre elsewhere. Apophyllite cleaves easily into thin folia parallel to the basal plane. Its hardness is from 4.5 to 5, and its specific gravity about 2.3. It occurs in many parts of the world. Beautiful crystals, three or four inches across, are found in India, and others nearly as large have been found at Bergen Hill and Paterson, N. J.

APOPLEXY. See BRAIN, DISEASES OF.

APOSIOPESIS, ăp'ŏ-sĭ-ō-pē'sĭs, a rhetorical term denoting a sudden break or stop in speaking or writing, usually for mere effect or a pretense of unwillingness to say anything on a subject; as, "his character is such —— but it is better I should not speak of that."

APOSPORY. Apospory is the natural complement of apogamy (q.v.). It may be defined as the production of a gametophyte from a sporohyte (see ALTERNATION OF GENERATIONS) without the intervention of a spore. The word means that the spore has been left out. Apospory was first discovered in the common bracken fern (*Pteris aquilina*), where it occasionally appears as an interesting freak. Tissue near the border of the leaflet, which normally develops sporangia containing spores, grows out into thin ribbon-like structures bearing some resemblance to ordinary gametophytes (prothallia). These structures bear the antheridia or archegonia or both, which give rise to the sperms and eggs, and, therefore, constitute a sexual generation. A transverse section of a normal leaflet of the bracken fern bearing normal sporangia (*s*) is shown in Fig. 1; while Fig. 2 shows a leaflet in which prothallia (*p*) with antheridia (*a*) have developed instead of sporangia. A comparison of the two figures shows that apospory is a "short cut" in the life history, since, normally, a spore in the sporangium would have given rise to the prothallium. In some ferns, under moist conditions, the tips of the leaflets may develop into prothallia bearing archegonia and antheridia. In a few ferns, the first leaf of the young sporeling, if bent over and brought into contact with moist soil, may produce prothallia along its border. Other instances of apospory in ferns might be cited, but no case has yet been reported for lycopods or equisetums. Apospory occurs in liverworts and mosses, but is not common, and no case has been proved in Gymnosperms. In Angiosperms there are several cases, including the common dandelion, in which the egg-bearing generation (embryo sac) does not develop from a normal spore and we must admit that apospory is present. All these plants, however, develop their embryos from eggs without fertilization and, consequently, are apogamous, as well as aposporous. This type is so closely associated with *Parthenogenesis* (q.v.) that it well may be considered under that heading.

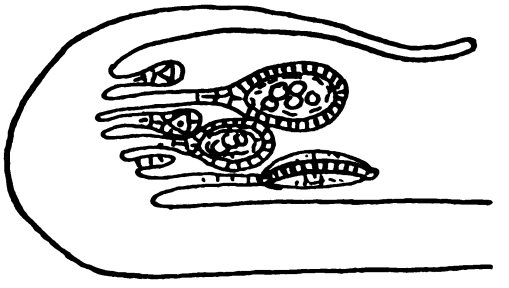

FIG. 1

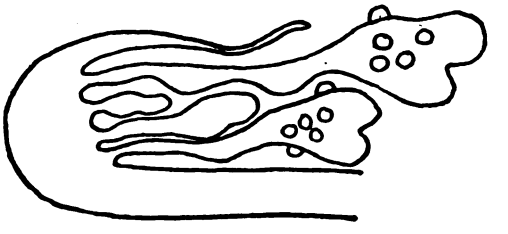

FIG. 2

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APOSTASY (Greek, *apostasis,* a standing away from), a term signifying a renunciation of opinions or practices and the adoption of contrary ones, and usually applied to renunciation of religious opinions. It is always an expression of reproach. What one party calls apostasy is termed by the other conversion. History mentions three eminent apostates — Julian the Apostate, who had never been a Christian except nominally and by compulsion; Henry IV, King of France, who thought that "Paris vaut bien une messe," and that of course all France was worth the whole Catholic faith; and William of Nassau, the stadtholder, who separated himself from the Roman Catholic Church and became a Protestant. The statute 9 and 10 of William III, cap. xxxii, provides that if any person educated in or having made profession of the Christian religion shall deny it to be true, he shall be rendered incapable of holding any office for the first offense, and for the second shall be made incapable of bringing any action, of being guardian, executor, legatee or purchaser of lands, and

shall suffer three years' imprisonment without bail. This act is commonly called the "blasphemy act."

A POSTERIORI. See A PRIORI.

APOSTLE (literally one sent out, from the Greek *apostellein,* to send out) and in the Christian Church the title given to the 12 men whom Jesus selected to attend Him during His ministry, witness His miracles, learn His doctrines and thus be able to promulgate His religion. Their names were Simon Peter and Andrew his brother; James the greater, and John his brother, who were sons of Zebedee; Philip of Bethsaida; Bartholomew; Thomas; Matthew; James, the son of Alpheus, commonly called James the less; Lebbeus, his brother, who was surnamed Thaddeus, and was called Judas or Jude; Simon the Canaanite; and Judas Iscariot. Of this number Simon Peter, John, James the greater and Andrew were fishermen; and Matthew a publican or tax-gatherer. When the apostles were reduced to 11 by the suicide of Judas, who had betrayed Christ, Matthias was chosen by lot on the proposition of Saint Peter. Soon after, their number became 13 by the miraculous vocation of Saul, who, under the name of Paul, became one of the most zealous propagators of the Christian faith. The Bible gives the name of apostle to Barnabas also, who accompanied Paul on his missions (Acts xiv, 14), and Paul seems to give it to Andronicus and Junia, his relations and companions in prison. Generally, however, the name is used in the narrower sense to designate those whom Christ selected himself while on earth, and Paul, whom he afterward called. In a wider sense those preachers who first taught Christianity in heathen countries are frequently termed Apostles; for example, Saint Denis, the apostle of the Gauls; Saint Boniface, the apostle of Germany; Saint Augustine, the apostle of England; the Jesuit Francis Xavier, the apostle of the Indies; Adalbert of Prague, apostle of Prussia proper. Tradition reports that several of the early apostles were married. The wife of Saint Peter is said to have accompanied him on his journeys, and died a martyr. The tradition further states that Saint Peter had a daughter Petronilla, who was also a martyr; this at least say Saint Augustine, Saint Epiphanius and Saint Clement of Alexandria. Saint Philip also is said to have been married and to have had several daughters, among whom was Saint Hermione. Hegesippus speaks of two martyrs, grandsons of Saint Jude. His wife was called Mary. Saint Bartholomew is also said to have been married. Their history is largely a matter of tradition, save as it is recorded in the Acts of the Apostles.

APOSTLE OF THE ARDENNES, title bestowed on Saint Hubert, son of the Duke of Aquitaine. He was made bishop of Liége in 708 and died in 728 A.D. About 800 his body was transferred to the Benedictine monastery of Andoin, in the Ardennes, which soon came to be called Saint Hubert. See HUBERT, SAINT.

APOSTLE OF THE ENGLISH, title bestowed on Saint Augustine, who, with several companions, was sent as missionary to England by Pope Gregory I, whose interest in that people had been aroused by seeing some captives of that race exposed for sale in the public mart at Rome. Saint Augustine is rather the Apostle of Kent than of all England, since his labors were confined entirely to the southeastern part of the country. See AUGUSTINE, SAINT.

APOSTLE OF FREE TRADE, title bestowed on Richard Cobden (q.v.), because of his constant advocacy of the repeal of the high-tariff schedules prevalent in England in 1830–46. He foresaw the rise of American competition with England's manufactured products, and pointed out the disadvantages which would arise from a policy of high protective duties and showed that the best policy was that of free trade.

APOSTLE OF THE FRENCH, title of Saint Denis, patron of France, who suffered martyrdom at Paris in 272 A.D.

APOSTLE OF THE GENTILES, appellation of Saint Paul, who undertook "to preach the Gospel to all mankind."

APOSTLE OF GERMANY, title bestowed on the English missionary, Saint Boniface, d. 755, for his untiring labors in Christianizing the German tribes. See BONIFACE, SAINT.

APOSTLE OF THE HIGHLANDERS. Saint Columba, founder of the monastery of Iona in the 6th century and missionary to the Scots of Alba, is known by this title. See COLUMBA, SAINT.

APOSTLE TO THE INDIANS, title given to John Eliot (q.v.) for his efforts in Christianizing the Indian tribes of New England in the 17th century.

APOSTLE OF THE INDIES. Name given to Bartholomew de Las Casas (q.v.), a Dominican monk, whose untiring efforts for the spiritual and temporal betterment of the American aborigines show him to have been far in advance of his time.

APOSTLE OF INFIDELITY, term applied to Voltaire (q.v.), for his persistent attacks on organized Christianity, and for the protection afforded by him to those whom he believed persecuted or hounded by the clerics of his day.

APOSTLE OF IRELAND, title applied to Saint Patrick, who, about 432 A.D., began his mission of converting Ireland to the Christian faith, a work which he brought to a successful conclusion before his death in 493 A.D. See PATRICK, SAINT.

APOSTLE TO THE SCOTS, appellation given the Scottish reformer John Knox for his efforts in spreading the doctrines of Calvin in Scotland. He is also styled the Apostle of the Scottish Reformation. See KNOX, JOHN.

APOSTLE SPOONS, a name applied to sets of spoons with handles formed of images of the Twelve Apostles and the Virgin. Such sets were common as christening gifts as late as the 17th century. Sets of this kind are now rare and when complete fetch fancy prices, a set being sold some years ago in London for $24,000.

APOSTLE OF TEMPERANCE, title given to the Rev. Theobald Mathew, a native of Cork, Ireland, who performed heroic work in the cause of temperance in the first half of the 19th century. He brought hundreds of thousands under the banner of temperance in

Ireland, Scotland and the United States. See MATHEW, THEOBALD.

APOSTLES' CREED. See CREEDS AND CONFESSIONS.

APOSTLES' ISLANDS, or THE TWELVE APOSTLES, the name given to a group of 27 islands in Lake Superior, belonging to Wisconsin. The principal islands of the group are Ile au Chêne, Stockton, Bear, Madeline, and Outer. They have an area of 200 square miles. Brown sandstone is exported and the islands are covered with a rich growth of timber. The cliffs have been worn into strange forms by the action of the waves. La Pointe, on Madeline Island, formerly the county-seat of Ashland County, Wis., was settled by the French, who established Jesuit missions on the islands as early as 1680.

APOSTLESHIP OF PRAYER, a pious association founded in France in 1844 by Rev. Francis Gautrelet for the purpose of advancing its members in the spiritual life and particularly of honoring the Sacred Heart of Jesus. There are three degrees of membership, composed of those who promise to make the morning offering of their thoughts, words, actions and sufferings to God in union with the intention of Christ; those who recite once each day the Lord's Prayer and the Hail Mary 10 times; and those who receive Holy Communion monthly as an act of reparation to the Sacred Heart of Jesus. The membership throughout the world is supposed to be about 30,000,000, and there are about 5,000,000 in the United States. The central office is at Saint Francis Xavier Church, New York.

APOSTOLIC BRETHREN, APOSTOLICI, or APOSTOLICS, the name given to certain sects who professed to imitate the manners and practice of the apostles. The last and most important of these was founded about 1260 by Gerhard Segarelli of Parma. They went barefooted, clothed in white, with long beard, disheveled hair and bare heads, accompanied by women called spiritual sisters, begging, preaching and singing, throughout Italy, Switzerland and France; announced the coming of the kingdom of heaven and of purer times; denounced the papacy and its corrupt and worldly Church; and inculcated the complete renunciation of all worldly ties, of property, settled abode, marriage, etc. This society was formally abolished (1286) by Honorius IV. Segarelli was burned as a heretic in 1300. Another leader now appeared, Dolcino, a learned man of Milan. In self-defense they stationed themselves in fortified places whence they might resist attacks. After having devastated a large tract of country belonging to Milan they were subdued (1307) by the troops of Bishop Raynerius in their fortress Zebello, in Vercelli, and almost all destroyed. Dolcino was burned at Vercelli, 1 June 1307. The survivors afterward appeared in Lombardy and in the south of France as late as 1368.

APOSTOLIC CHURCH, the Church in the time of the apostles, constituted according to their design. The name is also given to the four churches of Rome, Alexandria, Antioch and Jerusalem, and is claimed by the Roman Catholic Church and occasionally by the Episcopalians.

APOSTOLIC CONSTITUTIONS AND CANONS, a collection of regulations attributed to the apostles, but generally supposed to be spurious. They appeared in the 4th century, are divided into eight books and consist of rules and precepts relating to the duty of Christians, and particularly to the ceremonies and discipline of the Church.

APOSTOLIC DELEGATE, a permanent representative of the Pope in a foreign country. The term is sometimes confounded with the word ablegate, the latter meaning a temporary representative of the Pope for some special function.

APOSTOLIC FATHERS, the disciples and followers of the apostles, more especially those that have left written records behind. Many of these writings are in the nature of continuations of the apostolic epistles and throw much light on the early history of the Church. These writings comprise the Epistle of Clement of Rome and the so-called Second Epistle (which is not his); the seven Epistles of Ignatius of Antioch; the Epistle of Polycarp of Smyrna; the Martyrdom of Polycarp; the Teachings of the Apostles; the Epistle of Barnabas; the Shepherd of Hermas; the Epistle of Diognetus; the fragments of Papias and the Reliques of the Elders. Editions of these writings have been published by J. B. Cotelerius (Paris 1672); W. Jacobson (Oxford 1838); C. J. Hefele (Tübingen 1839); A. R. M. Dressel (Leipzig 1857); Gebhardt, Zahn and Harnack (Leipzig 1876–78; text ed. 1877; 3d ed. 1900); J. B. Lightfoot (texts and English trans. London 1891, 2d ed. 1893).

APOSTOLIC MAJESTY, a title granted by the Pope to the kings of Hungary, first conferred on Saint Stephen, the founder of the royal line of Hungary, on account of what he accomplished in the spread of Christianity.

APOSTOLIC PARTY, a name given to a body of Spanish fanatics who early in the 19th century clamored for the restoration of the Inquisition. About 1830 they became merged in the Carlist party.

APOSTOLIC SEE, official title of the seat of the Pope of Rome, who, according to the doctrine of the Catholic Church, is the apostolic successor of Saint Peter.

APOSTOLIC SUCCESSION. The doctrine of the direct and hierarchical succession from Christ's apostles. Its defenders maintain that the Christian ministry is a succession, that valid ordination is transmitted to the clergy only by accredited bishops who have received the power of ordination in direct line of succession from the apostles. The points of controversy are (1) as to when and how the exclusive authority of ordination was given by Christ and the apostles; (2) by what act, if any, the transmission of this authority is to be made valid; (3) along what lines has this supernatural commission come; and (4) whether or not this supernatural grace and spiritual authority are restricted to definite official lines of transmission. In later years differences have arisen among the Anglican scholars regarding these various points. Independents and Dissenters in England, of course, argue in favor of the theory that the Church itself as a body may constitute a legitimate ministry, with full

powers of ordination, etc. This in general is the attitude of non-prelatical bodies. In defense of the doctrine consult Gore, 'The Church and the Ministry' (1892); in opposition consult Brown, John, 'Apostolic Succession' (1898). Consult also Brightman, 'What Objections have been made to English Orders' (1896); Denny, 'Anglican Orders and Jurisdiction' (1893); Haddan, 'Apostolic Succession in the Church of England' (London 1869); Moberly, 'Ministerial Priesthood' (1898).

APOSTROPHE, a term in rhetoric indicating a figure of speech by which, according to Quintilian, a speaker turns from the rest of his audience to one person, and addresses him singly. Now, however, the signification is wider, including cases in which an impassioned orator addresses the absent, the dead, or even things inanimate.

The name is also employed in grammar to denote the substitution of a mark like this (') for one or more letters omitted from a word, as *tho'* for *though*, *'twas* for *it was*, *king's* for *kinges*. It is also applied to the mark indicating such substitution, especially in the case of the possessive. The old possessive singular was *es*, and the apostrophe stands for the omitted *e*.

APOTHEOSIS, a Greek term indicating the ceremony by which a man was raised to the rank of the gods. The custom of placing mortals who had rendered their countrymen important services among the gods was very ancient among the Greeks, who generally followed in so doing the advice of an oracle. On their coins most of the founders of cities and colonies are immortalized as gods; and in subsequent times living princes assumed this title. The Romans for several centuries deified none but Romulus, and first initiated the Greeks in the fashion of frequent apotheosis after the time of Cæsar.

APPALACHIAN AMERICA, a term used to designate the southeastern mountain region of the United States. This territory has a certain sociological unity, based on physical conditions, which was long obscured by the fact that it was parceled out among several different States.

Physiographically it is a mountainous territory without arms of the sea, inland lakes or other national waterways; and furthermore it is a territory which forbids canals. Its universal characteristics are difficulty of communication, isolation and remoteness. These conditions were less severe, and were largely overcome by greater commercial and intellectual activity in the portions of the Appalachian system which lay in the northern free States. Accordingly, as a sociological grand division, Appalachian America begins with the southern boundary of Pennsylvania and the Ohio River, and embraces the mountainous portions of the Virginias and Carolinas, Kentucky and Tennessee, Georgia and Alabama. In this vast area, which is all a land of saddles and bad roads, there are, of course, great varieties of elevation and climate from the "dissected plateaus" of Kentucky to "the land of the sky" in North Carolina. Descriptions of the geological formations, minerals, forests and other resources, and physiographic conditions appear under the several States. But the one great fact about the whole territory is that it condemns its inhabitants to the ills of isolation.

Historically Appalachian America received its first sparse settlements about the time of the Revolutionary War. A great tide of migration passed through it and around it to the west, and the valley land was occupied by hardy settlers. It was these who fought the battle of King's Mountain, and in the War of 1812 riflemen from the mountains gave material assistance in defeating the British at New Orleans. When the slave power developed in the South subsequent to the Revolution, Appalachian America, retaining its revolutionary spirit of liberty, came to be looked upon with hostility by its Southern neighbors. Slavery was never common in the mountains, and the scorn of the slaveholders for those who did not hold slaves was heartily returned by the mountaineers. Thus social barriers were added to the barriers of nature and the mountain people still further isolated from the world. In the Civil War, however, they emerged from their obscurity and surprised both the North and the South by their vigorous and effective stand for "union and liberty." They held Kentucky in the Union, made West Virginia "secede from secession," well-nigh divided Tennessee, and furnished recruits to the loyal armies even from Alabama and South Carolina. Many of these recruits were not enrolled as coming from these States, but the regular regiments enlisted from slave States, nearly all from the mountains, aggregated about 200,000 men. The sufferings of the loyal people throughout the mountains, and especially in East Tennessee, and the eloquence of "Parson Brownlow," for the time fixed the attention of the nation. Naturally the mountaineers have since the war followed the fortunes of the Republican party.

Sociologically Appalachian America reveals most interesting survivals of the spirit, arts and conditions of colonial times. Within its area are many valleys and villages which differ from other parts of the United States only in superficial matters like the greater number of saddle horses and the more free hospitality. But there is an immense population (commonly estimated at 2,000,000) which has been little affected by modern ideas. The stock is mainly British, representing rural England and the Scotch-Irish, though with traces of the Huguenot and the German. A large number of Washington's soldiers settled in the valley land of Appalachian America, and there is no evidence that the pioneers of the mountain region were in any way inferior to the first settlers in the more favored "blue grass sections." The early settlers had the education of their time, which lessened in succeeding generations. The conditions of life grew harder when the valley land and game were exhausted, and the public school did not come in until the "reconstruction period." As a result, a great part of all the native-born illiterates in the United States—many of them people of good character and good abilities—are in this region. In some counties the illiterate white voters exceed a third of the whole number. It is among these people that we find a survival of pioneer conditions—the woodcraft, the log cabin, the open fireplace—with a noble stone chimney in Kentucky, degenerating into a stick

and mud chimney farther south. The arts of spinning, dyeing and weaving are still found, together with a wealth of Saxon speech, and even old British ballads which have come down by oral tradition. Survivals in language consist of ancient pronunciations and constructions, and the persistence of words and meanings elsewhere obsolete; as "pack" for carry, "gorm" meaning to muss, etc. A kind of minstrelsy still exists among the ruder classes, so that we may find drinking songs and folk-lore still in the making. Preachers are few and poorly paid, and religion is of a mediæval and fatalistic type. The feuds and homicides which attract so much attention belong with these other survivals. Weapons are carried to some extent in all parts of the South, because men retain the Elizabethan idea that while the government protects the land from foreign foes, each man is to protect his private honor and interests with his own right arm. In the mountains this view is more plausible because the law is not always carried out with the certainty and majesty which could inspire either confidence or dread. Considering these adverse conditions of life, the general good order and morality of the mountains is very creditable. A woman or a stranger who behaves properly is always safe. The chief disorders arise from corrupt political leaders and the whisky bottle, and the mountain people have taken the first great step of progress in very generally enacting local option laws which prohibit the sale of intoxicants. Yet the "moonshine still"— the secret manufacture of spirits on which no tax is paid — survives in many places, and makes Christmas or election time a terror to the mothers of mountain boys.

A most striking characteristic is the absence of any foreign element in the population. The 35 mountain counties of Kentucky, for example, contain about 480,000 people, with only 2,000 or 3,000 who are of foreign birth, and these massed in a few counties where mines or lumber interests have been recently established. There are 15 counties each containing less than 10 persons of foreign birth. The massing of so great a population of purely American birth and breeding is very significant. And these people who owned land but did not own slaves (never to be confused with the "poor whites") constitute the true yeomanry of the South, its best nucleus for a true middle class. Large families are the rule, and the standard of physical development is high. With this large birth-rate the mountain region is approaching the limit of population and must either improve the means of subsistence or emigrate. Both movements have begun. In time the mineral wealth will bring railroads to a larger extent, and if proper educational guidance is furnished Appalachian America will become what Scotland is in Great Britain, a storehouse of national vigor and patriotism.

Printed information regarding Appalachian America is fragmentary and partial. Chas. Dudley Warner reported a charming tour 'On Horseback Through Virginia' and important notices occur in Fisk's 'Old Virginia and Her Neighbors,' Roosevelt's 'Winning of the West,' and Draper's 'King's Mountain and Its Heroes.' The spirit of war times is reproduced in Barton's 'Hero in Homespun,' and the general characteristics of mountain life appear in the tales of John Fox, Jr., and Mary N. Murfree ("Charles Egbert Craddock").

APPALACHIAN MOUNTAIN CLUB, the name of an organization interested in the exploration and study of the mountain ranges of eastern North America and the preservation of their woodlands, waters and historic sites for the use of the public. The club has published a journal, called *Appalachia,* devoted to the objects of the organization, since 1894. Headquarters, Boston.

APPALACHIAN MOUNTAINS, the great mountain system of the eastern United States extending from northern Alabama into the State of New York and according to the best recent opinion embracing also the New England system. Thus defined it includes a number of ranges and mountain groups of which the most important are the Alleghanies, the Blue Ridge, the Cumberland, the Black Mountains, the Catskills (formerly regarded as the northern termination), the White Mountains and the Green Mountain range extending northward to the Laurentian formations. But in comparison with this great length north and south, its measurements east and west are very moderate, the width at no point much exceeding 100 miles. The most remarkable feature of the general formation of the Appalachians is the regular arrangement of its ridges and valleys, these being, in general, parallel to the Atlantic coast line. This arrangement is particularly noticeable in the central part of the system, through Pennsylvania and Virginia. In general the ridges lie along two parallel lines from 50 to 100 miles apart, thus enclosing a longitudinal valley whose sides rise rather abruptly to culminating points of the mountains. This great central valley extends from New York to the southern end of the system, including the Cumberland Valley in Pennsylvania and the great valley of Virginia and of Tennessee. This region is very fertile throughout its whole length, and is especially well cultivated in Lancaster, Berks and Lehigh counties, Pa. The Appalachians show no remarkable elevations and the height of the summits appears less than it really is, because the mountains rise from a plateau varying from 500 feet in Pennsylvania to 1,500 and 2,000 feet in Virginia and Tennessee. The lowest peaks are found in Pennsylvania, none rising much above 2,000 feet. The culminating point of the whole system is Mount Mitchell, in the Black Mountains (6,711 feet); others of the high peaks, also found in the Black Mountain range, are Balsam Cone 6,671 feet, Black Brother 6,619 and Mount Hallback; the Smoky Mountains, too, include some high peaks, for example, Clingmann Dome 6,619, Guyot 6,636, Mount Alexander 6,447, Mount Seconto 6,612 and Mount Curtis 6,568. The culminating point of the northern part of the system is Mount Washington, New Hampshire (6,233 feet). The peaks are generally of rounded outline and lack the bold picturesqueness that characterizes the Rocky Mountains and other geologically "young" ranges in the western United States. Their low altitude and smooth contour are the result of the long-continued erosion which has removed great thicknesses of strata since the first uplift.

Geology.— The Appalachians show all geological formations from the metamorphic group of the Pre-Cambrian to the so-called coal-measures of the Carboniferous, the latter including sandstones, shales, limestones and coal. The strata of the western slope with their regular horizontal arrangement show a great contrast to the disturbed stratification of the eastern slope. There the rock formations are confused and pressed into folds and wrinkles with an inclination generally southeast. The strata of the system are all of marine or terrestrial origin, the latest being those of the coal formation. After the formation of these strata, probably during Permian time, the mountains were elevated to their present position by a force that proceeded from the southeast, working probably by many successive impulses. Subsequent erosion by rivers carved the gaps through the ridges so characteristic of the Appalachian topography and gave the mountains their present conformation. The chief minerals of the Appalachians are iron and coal. Iron ores, magnetite, hematite, and limonite, are very abundant; the magnetic iron is found especially in what is called the Champlain Iron District. The hematite and limonite ores are found all along the great Appalachian Valley and are of great commercial importance; while the earthy carbonite of iron found in many parts has been largely manufactured. Coal is perhaps the most important product; the coal deposits of the Appalachians include the whole anthracite field of Pennsylvania and New York with an area of 400 to 500 square miles, and the bituminous fields of Pennsylvania and other States, with an area of 56,000 square miles. Gold, silver, copper and lead are found in comparatively small quantities and are of little importance commercially, but the deposits of marble, limestone, fire-clay, gypsum and salt are abundant and valuable.

Drainage.— The Appalachians form the watershed between the Atlantic Ocean and the Mississippi River systems; this does not lie in one continuous line, but shifts its position from one line of ridges to another, so that many of the rivers cut their way through the mountains from west to east, or east to west; the Delaware and Susquehanna, for example, with their branches. These two rivers, with the Potomac and James, drain much of the eastern slope; the Ohio, with its tributaries, is the chief means of drainage on the western slope.

Flora and Fauna.— The mountain slopes are heavily wooded throughout the whole system. The white pine is found in all portions; the sugar maple, the white birch, ash and beech grow on the northern mountains; the oak, cherry, white poplar, white and yellow pine farther south. On the poorer lands the evergreens flourish, such as spruce, hemlock and balsam-fir, which, on account of their dark foliage covering the summits of the Black Mountains, have given this range its name. There are large quantities of flowering shrubs, particularly the rhododendrons, azaleas and laurel often growing in almost impenetrable thickets, and many varieties of smaller plants and flowers. Panthers and wolves have practically disappeared from the mountains, but bears, deer and wild-cats are quite common. Small game birds are plentiful and wild turkeys also on the southern ranges. Rattlesnakes and copperheads are found in all parts of the Appalachians, but not in great numbers.

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MARRION WILCOX.

APPALACHICOLA RIVER. See BOUNDARIES OF THE UNITED STATES.

APPAM CASE, The. In February 1916 the British steamship Appam was captured at sea by the German raider Moewe; a prize crew was put on board and the vessel was taken into Hampton Roads. Her British owners filed suit to recover possession of her from her captors. Federal Judge Edmund Waddill of Virginia, in a 15,000-word opinion, directed, 29 July 1916, that the vessel, with the cargo remaining aboard her and the proceeds of the perishable cargo already sold, should be restored at once to the British owners. The German government appealed to the Supreme Court of the United States, which on 6 March 1917 handed down a decision that a belligerent nation may not bring prizes of war into a neutral port. The Supreme Court held that it would be unneutral for the United States to permit either belligerent to bring prizes into American ports, and that Germany could not claim such right under any of the existing treaties between that country and the United States. In bringing the Appam into an American port, it was held, the German officials were committing a clear breach of American neutrality. Ship and cargo, valued at between three and four million dollars, were delivered to the British owners 28 March 1917. The decision, written by Justice Day, affirmed decrees by Federal Judge Waddill, and upheld the original ruling by Secretary of State Lansing that prizes coming into American ports unaccompanied by captor warships have the right to remain only long enough to make themselves seaworthy. The court stated that neither the Treaty of 1799 with Prussia, the Hague conventions nor the Declaration of London, entitled any belligerents to make American ports a place of deposit of prizes as spoils of war under such circumstances.

"The principles of international law," the opinion adds, "leaving the treaty aside, will not permit the ports of the United States to be thus used by the belligerents. If such use were permitted, it would constitute the ports of a neutral nation harbors of safety into which prizes might be safely brought and indefinitely kept.

«From the beginning of its history this country has been careful to maintain a neutral position between warring governments, and not to allow use of its ports in violation of the obligations of neutrality, nor to permit such use beyond the necessities arising from perils of the seas or the necessities of such vessels as to seaworthiness, provisions and supplies.»

APPARENT, a term employed by mathematicians and astronomers to denote things as they appear to the eye in distinction from what they really are. Thus they speak of apparent motion, magnitude, distance, height, time, etc. So important is this difference between reality and appearance, particularly in regard to the heavenly bodies, that we find all early astronomers, who were ignorant of this fact, running continually into error; and a great advancement in science was required before mankind was able to establish systems opposed to appearances. Every one knows that a body may appear to move while it is, in fact, at rest, and the motion is in the spectator, or the place on which he stands, as is the case with the sun in relation to the inhabitants of this earth. The apparent altitude of a heavenly body is what appears to be its angle of elevation above a horizon which may itself be apparent — that is, the seeming junction of sea and sky; or «sensible» — that is, a plane passing through the point of observation at right angles to the plumb-line; or true — that is, a plane parallel to the «sensible» horizon and passing through the centre of the earth. When the altitude of a heavenly body is measured corrections are made for refraction, parallax, and, if the measurement is from a visible sea horizon, for the height of the observer above the water.

The phrase heir apparent signifies one whose right of inheritance is indefeasible provided he survive his ancestor; as the eldest son or his issue, who must, by the course of the common law, be heirs to the father. Heirs presumptive are those who, if the ancestor should die immediately, would in the existing state of things be his heirs.

APPARITION, the name given to an illusion involuntarily generated, by means of which forms not present to the actual sense are depictured with intensity sufficient to create a temporary belief in their reality. It is now generally held to be the result of the reaction of an excited imagination, renovating past feeling or impressions, with an energy proportioned to the degree of excitement. But although the illusion thus generated is necessarily co-existent with the state of excitement in which it has its origin, or, in other words, ceases to be active when the phenomena vanish, it does not therefore follow that the mind, when it regains its ordinary condition, becomes immediately sensible of the hallucination under which it has for a time been laboring, or capable of distinguishing between perceptions of sense and phantasms of imagination. On the contrary, observation proves what theory equally sanctions, that the conviction of reality generally outlasts the impressions which originally produced it; and that, so far from any suspicion of illusion being entertained, or any power of discriminating the actual from the imaginary being evinced, this conviction takes entire possession of the mind, in many instances maintaining its hold with a firmness which all the force of argument and reason is insufficient to overcome. Hence the tenacity, and, we may add, the universality of the belief in apparitions; and hence also the prodigious diversity of forms under which these spectral illusions are presented in the popular legends and superstitions — a diversity, in fact, which seems commensurate with the incredible variety of influences, whether morbific or other, by which the imagination may be excited, and past feelings or impressions vividly renovated in consequence of its reaction on the organs of sense. Sir D. Brewster has remarked as a physical fact that «when the eye is not exposed to the impressions of external objects, or when it is insensible to these objects, in consequence of being engrossed with its own operations, any object of mental contemplation, which has either been called up by the memory or created by the imagination, will be seen as distinctly as if it had been formed from the vision of a real object. In examining these mental impressions,» he adds, «I have found that they follow the motions of the eyeball exactly like the spectral impressions of luminous objects, and that they resemble them also in their apparent immobility when the eyeball is displaced by an external force. If this result shall be found generally true by others it will follow that the objects of mental contemplation may be seen as distinctly as external objects, and will occupy the same local position in the axis of vision as if they had been formed by the agency of light.» This goes to the very root of the theory of apparitions, all the phenomena of which seem to depend upon the relative intensities of the two classes of impressions, and upon the manner of their accidental combination. In perfect health the mind not only possesses a control over its powers, but the impressions of external objects alone occupy its attention, and the play of imagination is consequently checked, except in sleep, when its operations are relatively more feeble. But in the unhealthy state of the mind, when its attention is partly withdrawn from the contemplation of external objects, the impressions of its own creation, or rather reproduction, will either overpower or combine themselves with the impressions of external objects, and thus generate illusions which in the one case appear alone, while in the other they are seen projected among those external objects to which the eyeball is directed, in the manner explained by Sir D. Brewster. It may be added that the reasoning applied to the impressions derived from the sense of sight is equally applicable to those received through the medium of any other sense,— as the ear, for instance, an organ which ministers abundantly to the production of spectral illusions. This theory explains only those apparitions known to be subjective illusions, but it does not account for those objective apparitions, of which there are many and well-authenticated accounts. Modern science has explained some of the objective apparitions.

APPEAL, a legal term signifying the removal of a cause from an inferior tribunal to a superior, in order that the latter may revise, and, if needful, reverse or amend, the decision of the former.

In the United States the distinction between an appeal, which originated in the civil

law, and a writ of error, which is of common-law origin, is that the former carries the whole case for review by the higher court, including both the facts and the law; while the latter removes only questions of law. An act of Congress of 1875 provides that the judgments and decrees of the Circuit Courts of the United States shall not be re-examined in the Supreme Court unless the matter in dispute shall exceed the sum or value of $5,000, exclusive of costs. No judgment, decree, or order of a Circuit or District Court, in any civil action at law or in equity, shall be reviewed in the Supreme Court on writ of error or appeal unless the writ of error is brought or the appeal is taken within two years after the entry of such judgment, decree, or order; save in the case of infants, insane persons and imprisoned persons, when the period is two years exclusive of this term of disability. An appeal from a District Court to a Circuit Court of the United States must be taken within one year. An appeal from the District Court in admiralty to the Circuit Court must be made immediately after the decree, in open court, before the adjournment *sine die;* and should be taken to the next succeeding Circuit Court. An appeal may be taken from the State courts to the Supreme Court of the United States, in cases involving the validity of a treaty or statute of, or authorized under, the United States, on the ground of repugnance to the Constitution, etc.

The effect of an appeal is generally to annul the judgment of the lower court so far that no action can be taken upon it until after the final decision of the cause. In many States, before the judgment of an inferior court will be reversed on the ground of error, the appellant, as the party taking the appeal is called, must show to the court that substantial injustice has been done him. In other States courts have held that when an error is shown to have been committed it will be presumed to have been prejudiced to the complaining party, and the judgment will be reversed unless the respondent shows that the error was harmless. Appellate courts, however, will not reverse the judgments of trial courts for technical or other errors where it appears from the record itself that the errors complained of were not prejudicial to the appellant.

In legislation an appeal is the act by which a member of a legislative body who questions the correctness of a decision of the presiding officer, or "chair," procures a vote of the body upon the decision. In the House of Representatives of the United States the question on an appeal is put to the House in this form: "Shall the decision of the chair stand as the judgment of the whole House?" If the appeal relate to an alleged breach of decorum, or violation of the rules of order, the question is taken without debate. If it relate to the admissibility or relevancy of a proposition, debate is permitted, except when a motion for the previous question is pending. Consult "Appeal and Error" (in 'Corpus Juris,' Vol. III, pp. 256–1449, New York 1914).

APPEARANCE, a legal term implying the coming into court as a party to a suit or action, whether as plaintiff or defendant. On the part of the plaintiff no formality is required. The appearance of the defendant may be effected by making certain formal entries in the proper office of the court, expressing his appearance, or in case of arrest it is effected by giving bail, or by putting in an answer or a demurrer.

APPENDICITIS, the name applied to an infectious disease of the vermiform appendix, a small organ occupying the lower right side of the abdominal cavity. The first authentic record of the distinct localization of a lesion in the appendix was made by Saracenus in a letter 28 Aug. 1642. A number of observers described the disease in later years, but it is to the honor and credit of American medicine that Reginald Fitz of Boston wrote his epoch-making memoir in 1886, 'On Perforative Inflammation of the Vermiform Appendix.' Two years later Fitz advanced the sound theory that the diseases variously described as typhlitis, peri-typhlitis, para-typhlitis, appendicular peritonitis, and peri-typhlitic abscess were all varieties of one and the same affection, namely, appendicitis. Rapid strides have been made during the last decade in the study of the disease, and mainly through the exertions of American surgeons the treatment of appendicitis has been placed upon a sound and rational basis. In the embryologic development of the human intestinal tract there is at first a straight tube, divided into the foregut, midgut and hindgut, each of which gives rise to different structures. From the midgut a diverticulum or pouch appears which marks the dividing line between the large and small intestine. This pouch becomes larger and is called the cecum, but its terminal portion does not keep pace with the growth of the base and remains as a small projection depending from the cecum. This is the appendix vermiformis; it has no function and from its liability to disease is merely a constant source of menace.

During early intra-uterine life the appendix lies near the umbilicus (navel), but at about the sixth month descends into the right iliac fossa. If two lines are drawn at right angles to each other, intersecting at the umbilicus, the abdomen will be divided into four quadrants. The lower right quadrant will include the right iliac fossa and in the majority of cases the appendix. The base of this organ will usually be found at a point two inches from the umbilicus on a line drawn from the latter to the anterior superior spine of the iliac bone and known as McBurney's point.

The appendix is held in place by a fold of peritoneum called the meso-appendix through which a single artery runs to supply the needed nutrition. The meso-appendix is derived from the lower layer of the mesentery, the fold of peritoneum which suspends the small intestine. In women there is usually also another blood-vessel which comes up to the appendix from the ovary. The end of the appendix is free and may point in any direction. This fact explains the great diversity of the symptoms often noted in appendicitis.

Bearing in mind, then, that the appendix is without a function, hangs in a dependent position from a portion of bowel always containing irritating material, and has a very poor blood supply, it can readily be understood why this organ is so often attacked by disease. It hangs in a cavity lined by peritoneum, a delicate membrane covering the inner surface of the abdomen and the exterior of the intestines, which easily

absorbs poisons and transmits them to the whole body. Inflammation of this membrane is known as peritonitis, a very fatal disease and often caused by appendicitis. Many deaths supposed to be due to peritonitis pure and simple are really caused by appendicitis. The intestines at all times are loaded with germs which under favorable conditions may be converted into deadly little organisms. These microbes attack the inner coat of the appendix, destroy it with the formation of pus, and may ulcerate through all the walls of the appendix causing an abscess, with peritonitis. But the recurrence of such a sequence of events requires certain other contributing factors. The old idea that foreign bodies, such as grape-seeds, are the cause of the disease, has been disproved. While foreign bodies are frequently found in the appendix, in rare instances only are they seeds, etc., but are almost always found to consist of masses of fecal material which having entered the appendix while soft, become dry and hard, and form a fecal concretion (*fecal calculus*). By exerting pressure on the wall of the appendix these hard bodies may aid in the production of the disease. In rare instances pins have found their way into the lumen of the appendix and induced appendicitis. It is interesting in this connection to note that worms are frequently discovered in the appendix. The *Oxyuris vermicularis*, or seatworm, has been found in large numbers completely filling the appendix, and the *Ascaris lumbricoides*, or roundworm, has sometimes occupied this organ. In studying the etiology of appendicitis we find that young persons are more frequently attacked than the older ones, the disease occurring less commonly after the 50th year of life. It is fortunate that such is the case, because older people, as a rule, do not stand operations so well as those in early adult life. Their resistance to shock is less, and their greater liability to kidney breakdown and to pneumonia would close their prognosis in many instances. The greater susceptibility of young adults to appendicitis is due to the more frequent disturbances of their gastro-intestinal tracts from dietary indiscretions, and, secondly, to the tendency to inflammation of the adenoid (glandular) tissues throughout the body during adolescence. Analogy is found in the predominance of lesions of the tonsils and of the glands in the neck and mesentery during the period of development. In children appendicitis is characterized by the intensity of the lesion as well as by the remarkable recuperative power which children have.

About two-thirds of all cases of appendicitis occur in males. The reason for such a disparity is due to several factors. Females are less exposed to inclemencies of the weather and other deleterious influence; they undergo less muscular exertion and the female appendix in the majority of instances, has a better blood supply. Of diseases that predispose to appendicitis may be mentioned: constipation, gastro-enteritis, dysentery, typhoid fever, influenza, etc. Constipation exerts an influence by causing sluggishness of the bowels, resulting in poor drainage of the appendix. Noxious materials may be retained and thus favor an increase in the virulence of bacteria, especially the *Bacillus coli communis*. Gastro-enteritis, or inflammation of the stomach and intestines, is a very important etiological factor in appendicitis. In this disease the cecum may become inflamed and by extension involve the appendix. In many instances the alterations in the walls of the appendix are slight and fail to produce any clinical manifestations. At times, however, the lining membrane of the appendix is directly attacked, with acute appendicitis as the result. Under other circumstances, catarrhal changes of mild degree persist and lead to chronic appendicitis. Dysentery and typhoid fever are among the more remote causes of appendicitis. They cause catarrhal alterations, swelling, congestion and œdema of the adenoid (glandular) follicles of the organ. Not uncommonly ulcerations occur, and the resulting scar is one of the most important factors in the subsequent development of appendicitis by causing a stricture in the lumen of the appendix, obstructing the drainage of the organ, and thereby favoring the retention of irritating material. Influenza owing to the intestinal lesions to which it gives rise may also favor the development of appendicitis.

In general it may be stated that the underlying cause of all cases of appendicitis is infection. Emphasis has more recently been laid on the rôle of the streptococcus group of microorganisms which frequently make their way into the circulation through the tonsils, adenoids and foci of suppuration about the teeth, as well as other portals of entry in the respiratory and gastro-intestinal tracts. It is probable, however, that this so-called hematogenous infection of the appendix is less common than direct infection from its own interior; the latter being favored by local abnormal conditions, such as kinks, adhesions, torsions, strictures, and contained concretions.

The most important predisposing cause of appendicitis is the fact that the appendix has already been the seat of one or more attacks of the same affection. The apparently greater number of cases of appendicitis observed in recent years is not due to an actual increased incidence of this disease, but rather to a greater refinement in diagnosis which has enabled physicians more readily to recognize the true nature of the malady, which in former years was variously styled inflammation of the bowels, peritonitis, gastritis, obstruction of the bowels, etc. The appendix is less resistant than other portions of the intestinal tract to the onslaught of bacteria and other deleterious influences. This is due to several factors: The blood supply may become defective because of the liability to partial or complete obstruction of the blood channels, as a result of kinking, twisting (*volvulus*), or the formation of external bands of adhesions, etc., secondary to primary inflammation of the appendix. Disturbances of circulation, and hence of nutrition, may also be produced by active and sometimes ineffectual muscular efforts of the appendix to rid itself of fecal concretions or even inspissated fecal matter. Defective drainage, which has been referred to, is of great importance in the pathogenesis of appendicitis because of the anatomical and physiological peculiarities of this organ. The average length of the appendix is about 8 to 9 cm. (3½ inches), while its diameter is only 3 mm. to 5 mm. (⅛ to ⅙ inch), thus forming a long narrow tube not favorable for

free drainage. The peritoneal covering forms what is known as the meso-appendix in such a manner as to draw the appendix into a curve and thus aid in any angulation resulting from disease. Additional factors of importance are the relatively large extent of mucous membrane presented by the appendix and the large amount of lymphoid (glandular) tissue, not only in the neighborhood of the valve-like opening into the cecum, known as Gerlach's valve, but also scattered throughout the wall of the appendix. The latter is of especial significance in view of the tendency of adenoid tissue throughout the body to inflammation when subjected to even slight irritation by bacteria and their poisons. An analogous condition may be observed in the tonsils, which are so frequently invaded by bacteria with a resulting tonsilitis (quinsy). Owing to this similarity the appendix has frequently been called the "abdominal tonsil."

In considering the symptomatology of the two forms of appendicitis — the acute and the chronic — it must be borne in mind that the extent of disease which has actually taken place in the appendix cannot always be determined by the clinical manifestations. While it is true that, in general, the clinical symptoms become more marked with the increased severity of the appendicular and peritoneal lesions,— that is, when perforation, abscess or gangrene supervene — it is also a fact that remission of all symptoms may occur, and yet the disease may be progressing to a fatal termination. It is likewise a fact that the symptoms suggestive of perforation of the appendix with abscess formation in one patient may, in another case, be due to the development of an abscess without perforation of the organ. It is better, therefore, to consider acute appendicitis as a clinical entity. Similar reasoning obtains with regard to chronic appendicitis, although in the latter the questions requiring solution are less complicated.

Acute Appendicitis.—There are three symptoms of acute appendicitis so constant and, when associated, so characteristic of the disease that they are designated the "three cardinal symptoms." These are pain, tenderness, and rigidity of the right lower quadrant of the abdominal wall. Pain is the initial symptom, and usually develops suddenly in an individual previously well. At the onset of the affection the pain is paroxysmal or colicky in character, coming in storms with intervals of rest, in which respect it simulates an attack of acute indigestion. The location is at first centred about the umbilicus, or the pit of the stomach, later it becomes diffused all over the abdomen, and finally localizes in the right iliac fossa. In recurring cases the initial pain of the later attacks is often referred immediately to the right iliac fossa. The pain of appendicitis may, however, be referred to any region of the abdomen. It is ignorance of this fact that leads to many errors of diagnosis in acute abdominal affections. The location of the pain depends to a great extent upon the position and direction of the appendix. For instance, with an appendix lying behind the cecum and pointing upward until its tip nearly reaches the gall-bladder, symptoms are produced resembling very closely those induced by affections of the latter organ. In other cases pain is felt in the left side of the abdomen and denotes that the appendix occupies a left-sided position or that it hangs into the pelvis. Tenderness upon pressure is one of the most valuable and constant signs of appendicitis. It is always present, but, unlike the subjective symptom, pain, it is limited at first to the site and the position of the appendix. To elicit this symptom abdominal pressure should be made in as light and delicate a manner as possible. The open hand should be laid over the tender area and the fingers gently depressed, ceasing as soon as the patient complains of pain. It should be remembered that the appendix may be distended with pus and on the verge of rupture, and any undue roughness in palpation may endanger the life of the patient. A celebrated German surgeon has truly said that "many a doctor who has sufficient practice and experience nevertheless never learns to palpate, since he is wanting in lightness of hand." It is a good plan to begin to palpate over on the left side away from the seat of pain, and gradually approach that region. As complications arise the point of tenderness may vary; for instance, in those cases previously referred to where the appendix occupies a pelvic position, the point of greatest tenderness will usually be found to the left of the median line. With the appendix thus located, where the disease has advanced to a stage where an abscess has formed in the pelvis, vaginal or rectal examination will reveal a point of resistance on the right side with more or less marked tenderness. The third cardinal symptom is rigidity of the right side of the abdomen and particularly of the rectus and other abdominal muscles. It is the most constant symptom of the three and appears shortly after the onset of the attack. It varies in degree in different cases, but is generally well marked, and is most intense over the site of the inflamed appendix. The variations observed range from rigidity so slight as to be barely appreciable up to a condition absolutely precluding any palpation, and to which the term "board-like" rigidity is applied. The degree of rigidity is usually, but not invariably, in direct proportion to the severity of the lesion. When the peritoneal cavity becomes involved and peritonitis develops the entire abdomen becomes rigid and board-like, followed by distension or tympany from paralysis of the intestines. While the three cardinal symptoms are the most important indications of acute appendicitis, there are other clinical manifestations that are more or less constantly present and are of value in arriving at a diagnosis. Among these are disturbances of the gastro-intestinal tract (nausea and vomiting, etc), elevation of the temperature, increased pulse and respiration, changes in the urine, etc. Nausea is practically a constant symptom in appendicitis and usually coincides with the initial pain; it may be followed by vomiting, which at first consists of the gastric contents, then of bile or bile-stained fluid, and finally, if septic peritonitis develops, of the contents of the intestines. This condition, unless seen early, has frequently been mistaken by the family physician for intestinal obstruction.

In cases of appendicitis which progress rather rapidly to peritonitis, with the marked nausea and vomiting characteristic of the condition, the pain suffered is apt to be very severe.

The attending physician, often following the promptings of the patient, administers the too-convenient hypodermic of morphine, which while relieving the patient, at the same time masks the symptoms and renders the task of the surgeon, called in for consultation, an exceedingly difficult one. The giving of morphine for the relief of pain in appendicitis is a pernicious habit. Nausea and vomiting rarely persist after the pain has become localized to the right iliac fossa, though in some unfavorable cases vomiting may be continuous and uncontrollable. The condition of the bowels previous to the attack of appendicitis is very variable. In the majority of cases constipation is observed, and such sluggishness may represent an etiologic factor of some importance. But there are many cases where diarrhœa ushers in the attack, and other instances when it may alternate with constipation. Fever must not be relied upon as a diagnostic sign, as it bears no direct relation to the gravity of the anatomical lesions. While with the onset of the disease the temperature usually rises to 101° and 102° F., it may return to normal again despite the advance of severe complications such as perforation or gangrene of the appendix. Coincident with the development of an abscess around the appendix there is usually a rise of temperature, but again such a rise is not constant. There are, finally, some cases in which the temperature continues high from the commencement to the termination of the attack, and yet the patient makes an easy recovery. The amount of fever should therefore be considered as the expression of the reaction and resistance of the individual to infection. The condition of the pulse is a more constant diagnostic aid than the temperature and its quality is of more importance than its rate of speed. If the pulse is strong, of good volume, regular, and the rate proportionate to the temperature, the outlook is favorable, and vice-versa. Variations in the respiration are not of much importance. The breathing is embarrassed in toxic states, from the distension of peritonitis, and sometimes, owing to the pain, the patient will use the chest muscles entirely. A quite characteristic position often assumed by the patient, and from which he resents being disturbed, is with the right leg and thigh flexed, while the left leg remains prone. In addition there may be perspiration, a furred tongue and a slight expression of anxiety upon the features. When the appendix occupies the pelvic position the patient will frequently complain of rectal and vesical (bladder) irritability. An increased frequency in urination is the usual symptom, yet there may be inability to void urine. The symptoms which have been described are typical of the usual attack of acute appendicitis, though marked variations may occur, depending upon the position of the appendix or the presence of adhesions from former attacks. With a history of previous more or less severe attacks of abdominal colic, not necessarily referred to the appendix, a person previously well is suddenly seized with severe pain, usually throughout the abdomen followed by nausea and sometimes vomiting, pain soon becoming more intense over the site of the appendix, and in a few hours this locality alone is involved; if such a patient should be so fortunate as to see his physician at this time, namely, within 24 hours of the attack, and if operation is advised and performed, recovery is practically assured; but unfortunately this is not always the course pursued. The disease at this time is in its earliest stage, with the inflammatory lesion confined to the appendix, and the particular sequence of events which may follow in a given case cannot be foretold. In some cases the appendix under the influence of rest is able to eliminate the noxious materials causing the inflammatory lesions, recover its vitality, and apparently return to as good condition as before the attack: but lymphoid (glandular) tissue which has once been the seat of infection is exceedingly prone to future attacks. In still other cases the disease extends through the wall of the appendix and induces a mild peritonitis localized in the coils of intestines and tissues immediately contiguous to the appendix. With the appearance of infecting bacteria or of their poisons in the peritoneal cavity, this membrane throws out a thin fluid or serum and an exudate (lymph) which organizes into firm tissue, known as adhesions. These adhesions glue the coils of intestine surrounding the appendix together, causing them to adhere to the roof of the cavity, which is the abdominal wall, and with the aid of the omentum, a fatty apron-shaped body covering the intestines, form a firm wall about a cavity containing the appendix and thus prevent the escape of toxic materials into the general peritoneal cavity. Should the disease, under medical treatment, subside, the lymphatics and the white blood corpuscles speedily destroy the infectious material, but the adhesions too often remain and cause constant irritation. In time a period of chronicity is reached when any unusual exertion provokes a dull ache in the lower right quadrant of the abdomen. The digestion is impaired, and the bowels become sluggish in their movements from the dragging of the adhesions upon the valve between the large and small intestines. In women subject to chronic appendicitis with involvement of the ovary and fallopian tube on the right side, slight attacks of appendiceal colic will recur during each menstrual period, and all treatment directed against dysmenorrhœa will prove unavailing. The appendix in such cases may become obliterated into a mere fibrous cord, or, more commonly, occlusion takes place at the opening into the cecum or at the site of a stricture, and the appendix becomes distended with clear mucus. While operations upon chronic forms of appendicitis in the presence of adhesions are attended with but little risk, the operation itself is more tedious and the incision longer than when the disease is operated on in its early stages. Having dealt with the favorable terminations of acute appendicitis, it remains to consider that far too numerous class of cases in which the appendix perforates, with abscess formation and sometimes general peritonitis. If the infection of the appendix is severe enough, its walls may become gangrenous and break down and perforate into the peritoneal cavity. In this case the peritoneum usually becomes infected in advance of the perforation and enough time is gained for the formation of adhesions such as have been described. In what is known as fulminating appendicitis the prog-

ress of the disease is so rapid that no adhesions are formed, and in 24 hours, or less, after the onset of the initial symptoms the patient may be suffering from a violent general peritonitis. But, as a rule, the escape of purulent material through a perforation in the appendix occurs into a preformed cavity, the walls of which consist of the abdominal wall, the iliac fossa, the cecum and matted coils of small bowel and the infiltrated omentum. This cavity becomes filled with pus and a true appendiceal or peri-typhlitic abscess is formed. The amount of pus varies from a teaspoonful to a pint, or in extreme cases even more. With the formation of the abscess the symptoms change somewhat. The severe pain of the early inflammatory stage becomes more dull; sometimes is referred to the back or to the left side, tenderness is increased, while the rigidity is more marked. The tongue becomes coated and the breath foul, chills are rarely observed even in the presence of pus, and when present — especially a single, severe chill ushering in an attack — usually mean a gangrenous condition of the appendix. There is fever, increased pulse-rate, and the patient shows the effect of absorption of poisonous products into his general circulation. An examination of the blood shows an increased number of the white blood corpuscles (leucocytosis). Palpation of the abdomen will reveal a mass in the right iliac fossa, rounded, hard and often tender. The patient may not complain of any pain beyond the dull ache referred to, though the act of coughing or taking a deep breath usually results in an exacerbation of pain. In some cases with an appendix deep in the abdomen and behind the cecum, an abscess may exist which cannot be palpated. When such a condition is suspected it is not wise to prod the abdomen too hard for fear of rupturing the abscess. If the pus extends into the pelvis the additional symptoms of vesical and rectal irritability will be present and vaginal or rectal examination will detect a bulging area extremely tender to the examining finger. In women and girls the effect of such a pelvic abscess is frequently disastrous. The open ends of the fallopian tubes become bathed with the pus, and either a salpingitis or occlusion of the tubes takes place. The tubes are thereby prevented from fulfilling their function of transmitting the ova to the uterus, and sterility may result. The extension of the pus upward toward the liver causes symptoms very much resembling infectious gall-bladder disease; this will be discussed under differential diagnosis. In neglected cases this upward extension of pus has resulted in the formation of an abscess beneath the liver, with rupture through or behind the diaphragm, and entrance of the pus into the lung and pleural cavity from which it has been actually evacuated by coughing and expectoration. If an appendiceal abscess is small, recovery may occur without operation, although such a happy result is doubtful. The disease is progressive, and the pus tends to increase, and if not evacuated will frequently rupture the walls of the containing cavity into the cecum, occasionally, but more often, unfortunately, into the peritoneal cavity, with a resulting general purulent peritonitis and almost invariably a fatal outcome. In such a case the pulse increases in frequency and becomes full and strong, the face becomes pinched and anxious, the eyes brighten, the mind becomes active, though delirium appears later, the abdomen slowly distends, accompanied by marked pain and restlessness of the patient. These three pathognomonic conditions, a bright eye, an active mind and a swollen belly, indicate approaching dissolution. The distension is due to a paralysis of the bowels, gas and feces being retained in spite of all treatment. Nausea and vomiting soon begin, the latter at first green, but later black, from evacuation of the contents of the intestines into the stomach. Death rapidly follows.

The diagnosis of appendicitis from other lesions of the abdominal cavity, if seen early, is comparatively easy in the great majority of cases. Particular attention should be paid to the history of the patient, and especially to the character of the onset of the illness and the earlier symptoms. While inflammation of the stomach and intestines (gastro-enteritis) has caused some confusion at times, yet, unfortunately, the mistake is made more often in the wrong direction. That is, a true attack of appendicitis is thought to be gastro-enteritis and treated accordingly until the appearance of an abscess with its unmistakable symptoms warns the attending physician of the true nature of the malady with which he is dealing. While the pain in both diseases may begin over the stomach (in the epigastric region) and continue over the whole abdomen, in appendicitis the region of the appendix will be tender to palpation from the onset, and this tenderness will persist and even become more acute after the general abdominal pain has ceased. Unilateral rigidity is quite constant in the beginning of the appendiceal attack, while in the gastro-intestinal disease the entire abdomen may be rigid. In certain cases of gastric ulcer, with perforation and escape of the stomach contents into the peritoneal cavity, the shock is more marked from the onset, and the more severe symptoms will occur in the upper abdomen. Ulcer of the stomach is much more common in women than in men, and often gives symptoms which can be recognized long before the ulcer has advanced to the stage of perforation. In enteritis, or inflammation of the bowels, and particularly when poisonous food products have been eaten, the symptoms produce early and often marked shock. In the summer months iced drinks are a frequent cause of this complaint. About 18 hours after the dietary indiscretion there will be marked general abdominal pain, diarrhœa, chilliness, perspiration and a feeling of great weakness. In severe cases the depression may be so pronounced as to cause death (acute ptomaine poisoning). The greatest area of tenderness will be found about the centre of the abdomen, and careful palpation of the appendix region may find this organ neither enlarged nor tender.

Mention was made earlier in this article of the symptoms produced by inflammation of an appendix behind the cecum and pointing upward toward the gall-bladder. In such instances the symptoms resemble very closely those due to inflammation of the gall-bladder and sometimes the two diseases cannot be differentiated with certainty. But as both affections require surgical intervention to effect

a permanent cure, and as the incision in both instances is made in nearly the same place, the failure to make a correct diagnosis is not detrimental to the patient. The pain in the gall-bladder affection, if referred, will cause a dull pain in the region of the liver radiating upward to the right shoulder blade. Tenderness is limited to the gall-bladder region and is a very important symptom, provided the rigidity of the right rectus muscle does not prevent palpation. The appearance of jaundice, or the characteristic gallstone colics should decide the diagnosis. Later in the progress of the disease, the infection of the gall-bladder may produce pus, or empyema, as it is called, and the gall-bladder can then be palpated as a round, tender and firm mass beneath the edge of the ribs and moving with respirations. An appendiceal abscess would rarely reach as high as the costal margin without implication of the right iliac fossa, but in a high position it might be mistaken for a ruptured gall-bladder following empyema. In such a case the diagnosis would be almost impossible and practically immaterial, since the condition makes an operation imperative. Neither an infected gall-bladder nor an appendix should ever be allowed to advance to the purulent stage without an operation being advised. Inflammation of the fallopian tubes has been mistaken for appendicitis and vice-versa, particularly when the tube leaking into the pelvic peritoneum causes a localized inflammation of that membrane. With the knowledge that the appendix frequently occupies the pelvis and may lie adjacent to the tube, the exact diagnosis of acute appendicitis from acute salpingitis may be difficult, and in chronic cases even more so. From the close proximity in which the two organs may be found the tube may be infected from the appendix or the latter may become involved secondarily from a pyosalpinx (pus in the tube). This still further complicates the differential diagnosis. If a history of specific infection can be obtained, with symptoms indicating the commencement of the disease in the lower part of the abdomen, and a vaginal examination shows induration of the vault with tenderness to pressure on either side of the uterus, a diagnosis of salpingitis would be reasonable. A number of other diseases may be suspected in deciding upon a diagnosis. Among these may be mentioned extra-uterine pregnancy, ovarian cysts, some kidney affections, intestinal obstruction, typhoid fever, pancreatitis, etc. The nature of this article does not warrant the full discussion of these affections.

The treatment of appendicitis has been a mooted question for some time, and it has only been within the last few years that the medical profession has accepted the dictum of those whose experience with the disease has been the greatest, that appendicitis is a surgical disease. The soundness of this teaching rests upon the fact that it is impossible to foretell in any individual case what the outcome will be, and which case will terminate favorably, or which will progress to perforation or gangrene, and the attendant peritoneal and other complications and sequelæ. It is essential that physicians appreciate the importance of early surgery, while a few patients for various reasons may refuse operation, the majority will depend upon the attending physician for advice and accept the treatment which he advocates.

The mortality of the early operation, before the peri-appendicular structures have become involved, is *nil*, barring accidents, and the incision in the rectus muscle can be so closely approximated that the abdominal wall is not weakened in the slightest by the operation. The peritoneum, the sheath of the rectus muscle and the skin, are usually sewed up in tier suture,—that is, in layers,—and the resulting scar, about two inches long, can barely be perceived after the lapse of several years. As the disease progresses the mortality increases in direct proportion to the extent to which the peri-appendicular structures have become involved. When an abscess develops, the search for the diseased appendix is difficult and often dangerous, and many surgeons simply evacuate the pus cavity and establish drainage. But the presence of a necrotic appendix is a constant menace, frequently causing secondary pus collections which may lead to a fatal termination. In all cases where pus is found the employment of drainage is imperative. This means that sterile gauze must be so disposed that the purulent material is caught up and carried off by capillary drainage, thus forcing the abscess cavity to heal from the bottom upward, and avoiding "pocketing." The course of these cases is tedious and the convalescence prolonged. The complications incident to acute appendicitis with abscess are attended with great risk to life. The most dreaded is peritonitis with invasion of the entire peritoneal cavity by the purulent and infectious products due to inward rupture of the abscess. Nearly every patient developing general peritonitis from an appendiceal abscess will die in spite of the most careful treatment and skillful operation. In advanced stages of the disease, when the appendix becomes necrotic and gangrenous, the cecum will frequently be implicated and be so diseased that the removal of the appendix cannot be followed by closure of the wound in the cecum. In cases of this character gauze must be so placed as to isolate the fistulous opening from the general peritoneal cavity, with the hope that granulation will lead to spontaneous healing of the bowel opening; but this does not always follow, and in such instances the hole in the cecum becomes a fecal fistula, discharging the contents of the bowel through the wound in the side. Fistulæ require very frequent dressing, heal slowly and are extremely annoying and disgusting to the patient. A third complication which may result in abscess cases is intestinal obstruction. The manner in which adhesions form has already been described. They are nature's barriers against infection, but sometimes they prove a veritable boomerang. The author has more regard for the results of the aseptic scalpel of the surgeon administered at the opportune time than he has for nature's attempts at cure. It is well known that after burns of the hands the resulting scar tissue will cause contraction and deformity of the fingers. In the same way the adhesions by uniting the coils of intestines together to prevent the spread of infection may encircle the bowel, and by contraction occlude its lumen, obstruct the flow of bowel contents and thus necessitate a second operation the mortality of

which is quite high. Finally, if convalescence is uninterrupted and the wound heals slowly by granulation, the resulting scar is quite weak and nearly always produces a hernia (rupture).

In consideration of the facts that the course of appendicitis can never be accurately foretold, and that the dangers resulting from delay in operation are many and severe, the following outline of treatment is justified from our present knowledge of this disease: Upon the appearance of severe pain in the abdomen, with the maximum intensity over the region of the appendix, nausea, or vomiting, and a point of tenderness in the right iliac fossa, the patient should be placed at rest, all food withheld and the family physician sent for. When the attending physician has made the diagnosis of appendicitis there is no treatment to be discussed save operative interference. Whether the operation should be performed immediately will depend upon the extent of peritoneal involvement, but this question should be decided by the surgeon called into consultation and in whose hands the management of the case belongs. In fatal cases which have been followed by a reopening of the wound, a study of the conditions is of great interest. When death has taken place from a rapid septic poisoning or toxemia the abdomen may show nothing except some thin cloudy fluid in the pelvis and congestion of the peritoneum covering the intestines, giving them a "scalded" appearance. In the abscess cases the right iliac fossa is found filled with a green purulent exudate adhering closely to the groin and the intestines. There may be small quantities of pus which have formed since the operation. If death does not occur for several days after operation, and nature fails to check the spread of the disease, this purulent exudate may reach from the liver to the pelvis with infection of the portal vein, the liver and the lymphatics behind the peritoneum. With extensive leakage, the entire peritoneal cavity may be filled with greenish pus.

There are many more cases of minor manifestations of appendiceal inflammation than of the acute disease. Both clinical and microscopical evidence proves that it is a great exception for an adult to have escaped some slight disease of the appendix. That it is possible to have a chronically diseased appendix, or occasionally even a high grade of acute inflammation of that organ, without symptoms is now definitely known; on the other hand, such conditions often produce symptoms which are so slight or non-characteristic that their origin or significance is entirely overlooked. The more typical cases of chronic appendicitis give rise to symptoms referable to the location of the appendix itself, that is, discomfort, distress of some sort or actual pain in the right lower quadrant of the abdomen. Occasionally, by reason of an abnormal situation of the appendix, the symptoms and signs may be either higher or lower than usual, or even, as occasionally happens, on the left side. Most curious and difficult of interpretation are the so-called referred symptoms. Through the medium of the nervous system and the interdependence of different portions of the gastro-intestinal tract, chronic irritation of the appendix may manifest itself by symptoms pointing to disease of an entirely different portion of the tract, most often the stomach and the duodenum. The function of the large intestine also may be disturbed, suggesting disease of that organ, whereas the primary source is to be found in the appendix. This so-called appendiceal dyspepsia is by no means uncommon and usually goes unrecognized until an attack definitely incriminating the appendix occurs. It is not far from the truth to say that appendicitis is the most common cause of dyspepsia. The only treatment of avail in such cases is removal of the offending organ, a procedure which often remedies diverse dyspeptic conditions in a most remarkable manner. Consult Brewer, G. E., 'A Textbook of Surgery' (New York 1915); Deaver, J. B., 'Appendicitis: Its Diagnosis and Treatment' (1913); Kelly, H. A., 'Vermiform Appendix and Its Diseases (1910).

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APPENZELL, ä'pĕn-tsĕl, Switzerland, a canton wholly enclosed within the territory of the canton of Saint Gall, and, though covering an area of only 162 square miles, divided into two independent portions, Ausser-Rhoden (101 square miles) or Outer-Rhodes, which is Protestant, and Inner-Rhoden (61 square miles), or Inner-Rhodes, which is Catholic. It is an elevated district, traversed by branches of the Alps; has large tracts of rich pasture-land and extensive forests of pine, and is watered by the Sitter and by several smaller affluents of the Rhine. Its climate is cold, but healthful. Glaciers occupy higher valleys. Flax, hemp, grain, fruit, etc., are produced, but the wealth of Inner-Rhodes, the more elevated division of the canton, lies in its numerous herds and flocks; that of Outer-Rhodes in its manufactures of silk, muslins, gauzes, cambrics and other cotton stuffs. The construction of railways has now made the canton more accessible, and great numbers of strangers flock hither annually to take advantage of the whey-cure establishments of Gais, Weissbad, Gonten, Heiden and Heinrichsbad. The inhabitants speak a peculiar dialect, which even those who are well acquainted with Swiss-German have great difficulty in understanding. The town of Appenzell (German, *Abtenzelle,* abbot's cell), is the capital of Outer-Rhodes, beautifully situated on the Sitter, with 5,126 inhabitants. Trogen, with 2,347 inhabitants, is the capital of Inner-Rhodes. Schools are numerous and education widely diffused. The division between the Protestant and Catholic portions of the canton has existed since 1597. They have each an independent local government with representation in the Federal Assembly. Pop. Outer-Rhodes (1910) 58,670; Inner-Rhodes (1910) 14,860. The former is one of the most densely-peopled parts of Europe, its population being equal to more than 500 per square mile. Consult Richman, 'Appenzell' (1895).

APPENZELLER, ä'-pĕn-tsĕl'-ĕr, **Henry Gerhart,** American missionary to Korea: b. 6 Feb. 1858; was drowned 11 June 1902 while on his way to attend a meeting of the Bible Translation Committee. He was a graduate of Franklin and Marshall College and Drew Theological Seminary. Soon after graduating from the latter he went to Korea as one of the first missionaries of the Methodist Episcopal

Church. He served the mission efficiently in many positions. He was superintendent, treasurer, manager of the book concern, editor of the official organ of the mission and one of the editors of the *Korean Repository*. His life has been written by William Eliot Griffis.

APPERCEPTION, a psychological term referring to higher consciousness. Until recently there has been considerable confusion among English and American writers on psychology as to the meaning of the terms perception and apperception. To point out the source of this confusion requires a brief history of the term apperception. The word was first used by Leibnitz in connection with his philosophy of "windowless" monads. With him every human soul is a monad which develops by an innner unfolding. When this development reaches the point of clear self-conscious being it attains what he calls apperceptive consciousness. If, on the other hand, the development is only partial, if its states are vague and only partially self-conscious, the monad has attained the level of perceptive consciousness. Thus for Leibnitz the terms perception and apperception designated simply different degrees of clearness and distinctness of consciousness, with no reference whatever to the apprehension of external things. In fact the theory of Leibnitz rendered any such use of the terms impossible. In more recent German psychology the term perception has been dropped and that of apperception retained as an expression of all the higher forms of clear consciousness. There is, however, one important exception to this. Wundt has retained both terms and attempted to restore to them their Leibnitzian meaning without, of course, committing himself to Leibnitzian monadology. Mental processes which are clear and distinct and are also under the control of volition are called by Wundt processes of apperception. But when the mental act is merely association in character and not directly controlled by volition, or when it is obscure, Wundt calls it an act of perception.

The philosophy of Herbart doubtless, more than that of any other German writer, has brought the term apperception into prominence in American psychology. If we consider his system we shall find that here again the terms perception and apperception mark different degrees of clearness and completeness of the forms of mental activity. With Herbart all mental processes are but the interactions of ideas. When a new idea enters the mind it causes a connection among the ideas already present. It disturbs the equilibrium. It is welcomed by the ideas akin to it, and opposed by those which are not. When it finally becomes adjusted and settled into its proper position among pre-existing ideas the new relation thus brought about is the result of apperception. Coming over to English and American psychology we meet with that difficulty and confusion referred to above. This confusion had its origin in the fact that in translating the Leibnitzian terms perception and apperception into English these same identical terms were used, regardless of the fact that in our psychology we had already a term, perception, which had acquired a fixed and definite meaning. The English word already in use stood for the recognition of objects through the senses, and this is still its meaning. Hence it stands for the clear and self-conscious recognition of things as well as the vague and imperfect apprehension of them. The term perception brought over from German psychology, and the same word already in use, thus stood for widely different meanings, and hence the confusion. The Germans have a wholly different word (*Wahrnehmung*) for what we mean by perception, and consequently they cannot understand our difficulty. The result is that we have all along used the terms perception and apperception as though they distinguished wholly different mental activities instead of marking only different degrees of the same processes, as they actually do. Apperception is only clear and self-conscious perception. It involves in a highly complex way the various mental processes of memory, imagination, judging, inferring, etc., when these processes are clear and self-conscious. A full treatment of apperception therefore requires that these processes be taken into account. It is only necessary here to indicate briefly something of the pedagogical bearing and value of the term. Mainly through the influence of the so-called Herbartian movement in America, this term apperception has centred attention upon, and emphasized the importance of, the processes involved and the conditions requisite for the successful acquisition and assimilation of new knowledge with that which has already been learned. As the bodily organism separates and assimilates only such elements of the food taken into it as are needed for its growth and repair, so in a somewhat similar manner does the mind select and appropriate only such of its presentations as manifest a certain kinship to what is already consciously and vitally present, and rejects the rest. Elements wholly foreign to the mind's present stock of ideas escape it altogether. We must therefore learn the new by means of the old. Hence before presenting the new it is necessary to call up and make alive, by arousing interest and curiosity, those ideas and materials of knowledge that by similarity or other bond or relation will best serve for the ready reception and complete assimilation of the truth or fact to be taught. The goal of intellectual development is mainly the acquisition of clear, distinct and adequate general conceptions, and the ability to make correct application of these to new particulars as they arise, or to see in each new fact the old in disguise.

In the development of such general conceptions, two stages are recognized which may be appropriately designated by the terms perception and apperception of German psychology, if these terms be employed without reference to whether the mental facts considered are externally or internally derived. The process in the first stage is for the most part involuntarily and unconsciously directed, in the second it is voluntary and self-conscious. The process is not, however, first, sense impression, then percept, concept, judgment and reasoning in turn, each leaving off where the next higher begins. It dates its origin far back in the mental history of each individual, and all along in actual experience, sensing, perceiving, conceiving, judging, etc., are inextricably joined in one indivisible movement of thought-development. To use James' expressive phrase, the infant's consciousness is a "big, blooming,

buzzing confusion.» This is the child's world. It is not, however, a world with which he can be satisfied. It must be broken in pieces and continually made over again. Chaos must be made cosmos, the irrational must become progressively rational. In fact, to rationalize the «big confusion» becomes the great and never-to-be-finished work of education and of life. Therefore the manner of this rationalization is of especial interest to the teacher. The «confusion» is not monotonous. It is not always the same. There is change. Certain elements come and go and some of them return again. By repeated recurrence these elements come to stand out in the foreground of the dark «confusion.» Some of them are uniformly repeated together simultaneously or in close succession. These consequently become associated and form the basis of perception. Perception occurs when the presentation of one element immediately calls up the others belonging with it in the unity of consciousness which these elements represent. The presented element or sensation becomes the sign to which the mind at once adds the proper interpretation and accompaniment. The richness of the interpretation depends upon the mind's present attitude and condition, and its past experiences with the object presented. In other words, in all perception there is more or less of apperception. See PSYCHOLOGY; ASSOCIATION OF IDEAS.

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APPERT, ą'pār, **Benjamin Nicolas Marie,** French philanthropist prominent in educational matters: b. in Paris 1797; d. 1847. He made a careful study of prison conditions, spending much time in this pursuit, his researches being published in his 'Journal des Prisons' (1825–30). He was much opposed to solitary confinement and is said to have taught 100,000 soldiers to read and write. Besides the 'Journal' he published 'Dix Ans à la Cour du Roi Louis Philippe' (1846), and 'Conférences contre le Système Cellulaire.'

APPERT, a'pār, **François** French scientist, brother of Benjamin Appert (q.v.): d. 1840. His method of preserving food without chemicals is given in his 'Art of Preserving Animal and Vegetable Substances' (1811). It is the familiar method of placing the article to be preserved in a can after heating, and then hermetically sealing it, and for his invention he was awarded a prize of 12,000 francs from the French government.

APPETITE, a term in its widest sense denoting the natural desire for gratification, either of the body or the mind; but generally applied to the recurrent and intermittent desire for food. A healthy appetite is favored by work, exercise, plain living and cheerfulness; absence of this feeling, or defective appetite (*anorexia*), indicates diseased action of the stomach, or of the nervous system or circulation, or it may result from vicious habits. Depraved appetite (*pica*), or a desire for unnatural food, as chalk, ashes, dirt, soap, etc., depends often in the case of children on vicious tastes or habits; in grown-up persons it may be symptomatic of dyspepsia, pregnancy or chlorosis. Insatiable or canine appetite or voracity (*bulimia*), when it occurs in childhood, is generally symptomatic of worms; in adults common causes are pregnancy, vicious habits and indigestion caused by stomach complaints or gluttony, when the gnawing pains of disease are mistaken for hunger. See DIETETICS; DYSPEPSIA.

APPIAN OF ALEXANDRIA, the governor and manager of the imperial revenues under Hadrian, Trajan, and Antoninus Pius, in Rome. He wrote a Roman history, from the earliest times to those of Augustus, in 24 books, of which only 11 have come down to us. It is written in Greek, in clear and simple style; but it is little else than a compilation, characterized by many inaccuracies and absurd blunders. The best modern edition is that of Schweighäuser.

APPIAN WAY, a famous Roman highway leading from Rome to Capua by way of Bovillæ, Aricia, Terracina, Formiæ, Minturnæ, Sinuessa, etc.; called by Statius *Regina Viarum,* the Queen of Roads. It was made by Appius Claudius Crassus Cæcus when he was censor, 313 B.C., and afterward extended to Brundusium by way of Beneventum. It was paved with hexagonal blocks of lava, exactly fitted to one another, resting on an admirable substructure of considerable depth, and there may still be seen, particularly at Terracina, important remains which prove its excellent workmanship.

APPIANI, ä'pę-ä'nę, **Andrea,** an Italian painter: b. Milan, 23 May 1754, of noble but poor family; d. in 1817. He visited Rome three times in order to penetrate the secret of Raphael's style of fresco-painting, and soon excelled in this art every living painter in Italy. He displayed his skill particularly in the cupola of Santa Maria di S. Celso at Milan, and in the paintings representing the legend of Cupid and Psyche, which he prepared for the walls and ceiling of the villa of the Archduke Ferdinand at Monza (1795). Napoleon appointed him royal court-painter, gave him the order of the Legion of Honor and that of the Iron Crown, and made him member of the Italian Institute of Sciences and Arts. Appiani painted afterward almost the whole of the imperial family. His best works are the fresco-paintings on the ceiling of the royal palace at Milan, allegories relating to Napoleon's life, and his 'Apollo with the Muses,' in the Villa Bonaparte. Almost all the palaces of Milan have fresco-paintings by him.

APPIUS CLAUDIUS CRASSUS, a Roman patrician, of the family of the Claudii. In 451 B.C., when the decemvirs were appointed to compose a complete legal code for Rome (afterward known as the Laws of the Twelve Tables), and to wield the supreme power in the

state for a year Appius Claudius was chosen one of the 10, and when the office was continued for another year he was re-elected. As he and some of his colleagues had ruled in a very tyrannical manner, the people had become incensed against them, and the following circumstances led to their overthrow. Appius Claudius had conceived an evil passion for a damsel named Virginia, the daughter of Lucius Virginius, a respected plebeian, and at his instigation Marcus Claudius, one of his clients, claimed Virginia as the daughter of one of his own female slaves and offered to prove this even to the satisfaction of her reputed father, while Appius Claudius decided that in the meantime she should remain in the custody of the claimant. This decision being directly contrary to law, and Icilius and her uncle Numitorius having exposed the decemvir's criminal designs, the aspect of the people became so threatening that he was forced to leave the maiden in the hands of her family, declaring, however, that he would finally settle the case next day. Virginius, hastily summoned from the army, appeared with his daughter next day in the forum in mourning robes and appealed to the people; but Appius Claudius, attended by a strong guard, again adjudged her to M. Claudius. Unable to rescue his daughter, the unhappy father snatched a knife from a butcher's stall and plunged it into her bosom, saying, "There is no way but this to keep thee free." Virginius escaped to the camp and with the army returned to Rome, demanding revenge. The decemvirs were deposed by the indignant people, and the government by tribunes and consuls restored 448 B.C. Appius Claudius died in prison or was strangled, while Marcus Claudius was banished.

APPLE. Horticulturists regard this tree and its fruit as the progeny of two original stems, the *Pyrus malus* and *Pyrus baccata*, all the common species of apples being modifications of the *P. malus* of Linnæus.

Origin and Antiquity.— The common apple appears in the mythology, traditions, history and archæology of the most ancient nations, the Bible, Code of Menu, Book of the Dead, Hesiod's 'Theogony' (v. 215). Its charred remains have been found in mud of the prehistoric Lake Dwellings of Europe, while it is represented with sufficient fidelity in some of the most ancient stone carvings. It is mentioned in the earliest annals of China, Babylon, Phrygia and Egypt. Relying upon its hybrid origin, it has been assigned by some horticulturists to Higher Asia, where the *P. malus* and *P. baccata* are most likely to have become associated; a theory, however, which is contested by others, who advance many reasons for its conventional origin in Asia Minor. No contest appears to have arisen with regard to the habitat of *P. baccata*, in Higher Asia. There were and are still *baccata* which, unless they came from Higher Asia, are indigenous to America. Such are the *P. ioensis*, or Prairie States' crab, and *P. coronaria*, or Eastern States' crab. The latter is a sweet scented fruit about three-fourths of an inch in diameter, which grew wild in all the Northern and Middle States. The tree was about 15 to 20 feet high, with light-green leaves and rose-colored blossoms, which appeared in May. This plant is now cultivated in all the States mentioned. There is also the *P. rivularis*, with yellow-red fruit, about the size of a cherry, native to the north Pacific, and eaten by the Chinooks; also the *P. angustifolia* of the Allegheny range; both of them native to this continent.

Appearance.— The apple tree (*P. malus*, order, *Rosaceæ*), as a rule, is not over 30 feet high, the trunk and branches crooked and gnarled, leaves short-stemmed, blossoms having permanent calyces and emerging in clusters. When in leaf, the tree presents that symmetrical outline which suggests long domestication. The fruit usually round, sometimes oblate or ovoid, depressed at both ends, varies in size from two to six inches diameter, with a white, crisp, watery, sweet (or acidulous) pulp, centred by a core containing several small brown seeds and covered by a thin glossy (sometimes russet) skin, which, when cut open, yields an agreeable odor. In some varieties this becomes quite pungent.

Uses.— When eaten raw the apple is used as common food or as dessert to meals. It can be baked, roasted, stewed or boiled, made into marmalades, jellies, tarts, pies, puddings, cakes, preserves, sauces, apple-butter, Chinese chop suey or French raisiné; in short, into very varied dishes. The expressed juice of selected apples forms a sparkling sweet cider, much esteemed and commonly drunk wherever the apple grows. Very strong cider is made by separating the water from the fermented juice. This is sometimes done by freezing, and skimming off the ice. Pomona wine is made by adding a gallon of brandy to six gallons of new cider, allowing the mixture to stand still several months, racking off and bottling for future use. Verjuice is a product of the crab apple, *P. baccata*. Apples, when pared, cut and dried in the sun, afford an excellent substance for pies and sauces. Pomatum, as the name indicates, used to be made by mixing apple pulp with lard. Apple-wood is of fine grain and hard enough, when stained black, to pass for ebony. It is also employed in the manufacture of furniture, shoe-lasts, small cog-wheels, buttons, oriental imitations of olive wood and other objects. Dwarf apple trees are sometimes cultivated simply for ornament, as when planted for hedges, forming very beautiful ones, when judiciously selected with regard to color of blossoms and fruit. They are also planted in limited grounds, when a variety of fruit is required to be produced in a narrow space. Many varieties grafted on the wild crab seedling grow successfully and become dwarfed. The French paradise apple, a small variety, dwarfs other varieties grafted upon it. It is less dwarf than the crab, and more dwarf than the Daucain or English paradise stock, another stock in common use for this purpose. The dwarfing of trees is carried to an astonishing degree in China and Japan, where trees not more than a single foot high are produced and kept in flower-pots holding scarcely more than a quart. In England, France and the Low Countries apples are trained not only as dwarfs, but more commonly as espaliers and balloon-shaped.

Apple crops exhibit great variance from year to year, sometimes halving and at other times doubling normal produce. The following

table shows a normal crop at the present time of about 240,000,000 bushels. Upon a rough computation, for which no accuracy is claimed, if 10,000,000 additional bushels of apples are annually reduced to cider and vinegar, the world's product of apples would amount to 250,000,000 bushels. Counting 200 apples to a bushel, the product would be 50,000,000,000 apples. As the Chinese, Japanese and other far eastern people export no apples and import but few, the product is substantially consumed in Europe, America and the colonies, which together contained, at the average date embraced by the table, about 625,000,000 people. This would make an average of 80 apples a year to each person, or 400 to the average family of five persons.

APPLE CROPS OF THE WORLD.
(Latest official returns and estimates).

Equivalents employed: 1 bbl. = 2 1-2 bushels, each of 50 lbs.; 18 bbls. = 1 long ton; 16 bbls. = 1 short ton.

Country.		Bushels.
United States of America, census, 1909		*146,122,318
Canada, 1900	18,626,186	
1911	10,618,666	
1915, average of three years		†14,622,426
Australia, including Tasmania and New Zealand, combined crop, average of three years.		5,000,000
United Kingdom, est		1,000,000
France, 1915, 206,361 met. tons, exclusive of cider and vinegar apples, and excluding colonies		3,714,498
Germany and Austro-Hungary, est		4,000,000
Luxemburg		40,000
Holland and Belgium, est		8,352,650
Italy, average crop		7,000,000
Spain and colonies, 1910		6,650,000
Russia, including Poland, Siberia, Caucasus, Crimea, etc		8,000,000
Turkish Empire in Europe and Asia		7,000,000
China (including Chinese Turkestan and Thibet) and Ladakh		9,000,000
Japan, 1912, 52,044,968 pounds		1,000,000
All other countries, say		18,498,108
Grand total		240,000,000

Value.— The average value of the apple crop of the United States of America, as shown in the last census, was about 66⅔ cents per bushel.

Packing.— Experience has demonstrated the necessity of extreme care and method in packing of apples for shipment, especially when intended for exportation; the California packers having exhibited such superior devices that they have been invited to instal them in Australia and other apple-growing countries. As yet, however, no uniform system prevails throughout the United States. Apples for shipment are packed in baskets, crates, boxes and barrels; the last two containers for export. The Northwestern standard box is 10½x11½x18 inches, equal to 2,173½ cubic inches; each apple being wrapped in unprinted paper and the box stuffed with paper, or fine shavings, to allow for shrinkage and the effects of jolting in transit. The barrel is 17⅛ inches in diameter at the head, 26 inches between heads, 64 inches in circumference at the bulge, with staves 28½ inches long, being somewhat smaller than its Canadian compeer. The latter, the legal apple barrel of Canada, is of a size to contain 96 imperial quarts; the Canadian apple-box measuring 10x11x20 inches of space, inside, equal to 2,200 cubic inches.

* Trees, U. S. A., 1910 of bearing age, 151,523,000; non-bearing age, 67,792,000; total trees, 219,115,000.
† Trees, Canada, 1911, of bearing age, 10,617,372; non-bearing, 5,599,894; total trees, 16,217,166.

Exportation.— During the calendar year ended 31 Dec. 1915 the exportation of domestic apples from the United States was as follows: Apples, green or ripe, 2,176,948 barrels, valued at $7,086,094, such exports being chiefly to the United Kingdom. Of apples dried, the exports were 33,905,608 pounds, valued at $2,671,601. The average value of the green apples was about $3.50 per barrel, and of the dried apples about eight cents per pound. A large proportion of the fruit exported to the United Kingdom was probably re-exported to other countries.

Varieties.— In addition to productiveness, an essential to the value of any food plant, the 12 points mentioned and explained below should be looked for in an apple variety. Of course all 12 of these qualities cannot be found greatly developed in a single variety because some are in a measure antagonistic, but by keeping these points in mind the prospective orchardist may avoid planting a variety that would not meet his own expectations or the market demands. (1) Richness, dependent upon the relative proportion of sugar to malic acid. When these are deficient in amount the fruit is insipid, but each may be present in large amount without making the fruit pronouncedly sweet or tart to the taste. Many tart apples contain more sugar than some of the so-called sweet apples. In ripe specimens of improved varieties the range of acid is from 0.19 to 1.11 per cent, and of sugar from 10 per cent or even less in poor sorts to 14 per cent or somewhat more, the usual range being from 11 to 13 per cent. (2) Flavor, a quality distinct from the taste of acid and sugar, and, like perfume, dependent upon minute quantities (seldom more than 0.5 per cent) of a volatile oil. A highly perfumed apple is, however, not necessarily highly flavored. (3) Firmness not sponginess, crispness not hardness, tenderness not softness, meltingness not juiciness are dependent upon cell structure. (4) Color is often of more importance in the uneducated market than form, size, richness and flavor combined. It is an unsafe index of the last two qualities, except that, as a rule, well-colored specimens are superior to poorly colored ones of the same variety. Color varies in all varieties with season, soil, management, etc. The favorite color in the general market is red. (5) Form: a nearly globular shape is most desirable because fruits of that form pack better without bruising than other forms. (6) Size and uniformity. In general, a diameter of about three inches and a weight of six or eight ounces is preferred, and a variety producing such as the bulk of its crop will usually, on account of the lessened necessity for grading, be more valuable than another variety of equal productiveness but with widely varying size of fruit. (7) Smooth, tough but thin skin resists insect and fungous attacks, injuries in handling and shipping, and is more economical with respect to waste. (8) Small core and few seeds save waste. (9) Maturity: The commercial variety should be ready to harvest all at once. (10) Firm adherence to the tree; self-evident. Defectiveness in this respect may be due to attacks of enemies. (11) Culinary qualities: of prime importance in commercial varieties because such are used mainly for cooking. Sweet varieties usually make in-

sipid pies but good baked apples; tart varieties make best pies and sauce. (12) Good-keeping is not dependent solely upon firmness but is usually associated with locality, climate, soil, etc., as well as with the variety and the stock upon which it is grown. Grafting and long domestication have resulted in several hundred varieties, some say 1,000. Even in Pliny's time, nearly 2,000 years ago, there were 22 varieties known to the Romans, many of them taking the name of the cultivator, a custom which prevails to the present day. Those varieties which are held in the highest esteem in the United States are the Baldwins, Newtown Pippins, Spitzenburgh Russets, Ben Davis, Gano, Black Gilliflower, Blue Permain, Grimes, Hubbardston, Yellow Newtown, Northern Spy, Rhode Island Greening, York Imperial, Rome Beauty, Wealthy, Stayman, Golden Russet, Oldenburg, Fameuse, Ralls, Gravenstein, Jonathan, Tompkins King, Missouri Pippin, Pennock, Peck, Twenty Ounce, Willow, Wine Sap, Wolf River and McIntosh Red.

A matter of importance in the selection of varieties of apples, and even more markedly of pears, is the determination of the fertility of the blossoms. Sterility, indicated by annual dropping of the fruit, may result from one or a combination of the following causes: Impotence of the pollen or the pistils, or the premature ripening of one or the other; injuries to the blossoms by fungous attacks, rain, frost, or continued cool weather or other cause more or less beyond the grower's control. On the other hand, it often results from impotence of the pollen to fertilize the pistil of the same variety and is noticed when trees stand singly or in blocks of one variety remote from other varieties. This may be obviated by the grower, who should plant varieties that blossom at the same time in proximity, usually in alternate rows through the orchard, or by grafting such in orchards already set. A practice resulting from this and the varying maturity of varieties with respect to fruit-bearing is the planting of "filler" trees in permanent orchards. The fillers are quick-maturing varieties of usually upright growth and small size, which are set alternately with the slower-growing, more-spreading permanent trees, and cut out when crowding seems to threaten. For such practice four varieties are usually selected, two fillers and two permanents, each pair blossoming at the same time. Each pair is placed alternately with the other and each member of the pair alternately with its partner. Trees in such orchards are often planted 28 feet apart on the diagonal, so that when the fillers are removed the permanents will be left in rectangles of about 40 feet, the usual distance recommended for large-growing varieties. Some growers plant as close as 30 feet, but this is too close except for trees of small growth. No other tree fruit than the apple should be planted in an apple orchard, because no two fruits demand the same treatment, and where two are planted, one or the other, perhaps both, must suffer more or less. See ORCHARD CULTURE.

Propagation.— New varieties of apples are propagated from seeds, but since seeds rarely improve upon the parent, seedlings are chiefly used to produce stocks for grafting or budding. Standard (that is, natural-sized) trees are so propagated. Dwarf trees result from grafting or budding the same varieties upon the small-growing, almost bush-like varieties, paradise and doucin, the stocks of which are produced by mound layering. Voluminous discussion has arisen concerning the relative advantages of grafting over budding, and also concerning certain methods of grafting. Opinions in the first case are very conflicting; in the latter they seem to favor the use of a small piece of apple-root as stock and a rather long scion to be set deeply in nursery and orchard in order to ensure the rooting of the scion and thus obtain a tree drawing its nourishment from its own roots instead of from the nondescript roots of the seedling stock. In northern rigorous climates very hardy varieties are selected upon which to top-work less robust sorts, thus to increase their hardiness. When the trees are set the tops must be cut back severely to balance the loss of root due to digging from the nursery and to start the head at the proper height from the ground. Formerly six feet was the usual length of trunk desired, but half that length is now preferred and in the central Western States even less. Trees with short bodies and low heads are less likely to be injured by wind and sun-scald than those with high heads and long bodies. Established unprofitable trees and undesirable varieties are often top-worked to valuable ones; not more than a third of such trees being grafted each year because of the danger of producing water-sprouts. See GRAFTAGE; PRUNING; TRANSPLANTING.

Soils, Fertilizers, etc.— Apples thrive upon nearly all kinds of soils, certain varieties being better adapted to light soils and others to heavy rather than the reverse in each case; but the great majority of the almost innumerable varieties succeed best upon medium to clayey loams, especially if they are somewhat elevated, inclined or rolling, and in a clear, dry climate. Since air and water drainage are usually good in such places the fruit produced is generally of fine color, flavor and size. Upon low lands and in damp climates the fruits are usually of inferior quality and the trees more susceptible to fungous attacks (see ORCHARD). The fertilizers demanded by apples are mainly potash and phosphoric acid (see MANURES). Some growers use a mixture of 100 pounds of muriate of potash to 200 pounds of 16 per cent superphosphate at the rate of 100 pounds an acre while the trees are small, increasing to 500 pounds and even as much as 1,500 pounds an acre for trees in full bearing, the amount depending upon the character and condition of the soil, and the grower's management. If cover crops (see GREEN MANURING) such as clover, vetches or cow-peas are grown, they will supply all the nitrogen needed; indeed, if long continued or if several very heavy crops be turned under, too much nitrogen may accumulate, and recourse to a cereal crop be necessary to remove the excess. Too much nitrogen induces a sappy, easily winter-killed growth, generally at the expense of fruit-production. Lack of nitrogen is indicated by pale green or yellowish foliage. The preparation of the land does not differ materially from that for other crops such as corn or potatoes, each of which is often grown the season previous to planting in order to fit the land for the orchard. The trees may

be set in spring or autumn and the cost of cultivation may be met by cropping the land for the first few years with potatoes, melons or some other low-growing, inter-tilled crop. Annual cultivation consists in an early spring plowing followed by narrowings at intervals of two weeks and after rains that form a crust until mid-summer, when a cover crop is sown to be turned under in the following spring. Deep plowing during the first five years or so will induce deep rooting which in after years will assist in withstanding drought and obviate the necessity of annual deep plowing. See TILLAGE.

Growers' opinions differ as to the length of trunk an apple tree should have, and also as to whether there should be a main trunk above the principal lower limbs, but all agree that a few (some growers say five, four or even three) well-placed main limbs are better than a large number. These mains should start far enough from one another to avoid the danger of splitting when under load of fruit, and should be made to rebranch near the main trunk. Some of these branches should be trained upward, the others more horizontally, so as to develop a well-rounded, symmetrical top. Four or five years' careful training should so fix the character of the tree as to obviate in great measure the necessity of subsequent pruning. See PRUNING.

Insects.— Several hundred insects feed upon the apple, but the most of them are so well controlled by their enemies or by natural checks that their injuries are seldom noticed. There are, however, many that are frequently troublesome, among which the following are perhaps the most commonly destructive. In connection with the specific means of control here mentioned, the reader should refer to the general article FUNGICIDE. (1) Codlin moth (*Carpocapsa pomonella*) is perhaps the best-known and most widely distributed apple pest. The eggs are laid upon the fruit, the larvæ almost invariably entering the calyx, burrowing through the flesh and causing premature ripening. Since two or even three broods are produced in a season, the destruction of the first by spraying is of prime importance. This spraying must be done before the calyx closes, because the caterpillar's first meal must be poisoned, to accomplish which the sepals must not have closed. A second spraying is recommended a month later. The destruction of culls, cores and parings and the use of moth-traps in the windows of storage-rooms also assist in controlling the pest. (2) Apple maggot (*Rhagoletis pomonella*), the footless grub (one-fifth inch long) of a two-winged fly, tunnels in the fruit and is especially troublesome in New York and New England, attacking thin-skinned summer and autumn varieties. Windfalls may be eaten by stock running in the orchard, and stored apples may be fumigated with carbon disulphide. (3) San José scale (*Aspidiotus perniciosus*), a minute scale insect of enormous prolificacy found upon many species of woody plants which in a few years die. When full grown it so closely resembles some of its relatives that a microscopic examination is necessary to determine its identity. When abundant, infested twigs have a somewhat scurvy appearance resembling a coating of ashes. From beneath the female scale the young appear, crawl to new feeding ground, fix themselves and reproduce with great rapidity. It has been estimated from careful records of close observations that more than 3,000,000,000 scales may be produced in a single season from one female. Spraying with kerosene emulsion, lime, sulphur and salt solution, or fumigating with hydrocyanic acid gas, are the popular ways of combating this pest. (4) Canker-worm, the larvæ of certain moths (species of *Anisopteryx* and *Paleacrita*), most common in the northeastern United States and adjoining Canada. They attack the leaves of apple, pear and some other trees, entirely defoliating them when especially abundant. The wingless females crawl up the trunks and lay their eggs upon twigs or bark. The larvæ, measuring-worms, appear shortly after the foliage from which, when disturbed, they drop at the ends of silk threads. If they reach the ground they climb the trunk to resume feeding. Pupation occurs in the ground. This climbing habit of both females and larvæ, especially of the former, suggested impassable bands upon the trunk as a means of control. To be most effective these must be applied just before the female begins to climb, and since those of one species are active in the late fall and upon warm days during the winter, and those of the other in the spring, the bands must be kept in good condition during most of the year. (Consult New Hampshire Experiment Station Bulletin, No. 85, 1901). (5) Tent caterpillars, the larvæ of a moth (*Clisiocampa americana*), attack various trees in a large part of the United States and Canada. The eggs are deposited in gluey-looking masses upon the twigs in summer and hatch in very early spring. The larvæ are gregarious, and spin a protective web from which they emerge to feed. When numerous they frequently strip large limbs or even trees of foliage. Gathering the eggs during the winter and cutting off the nests as soon as seen are the two most effective methods of control. Since several parasites attack the eggs of this moth, the egg masses should be kept out of doors in a place from which the parasites, but not the newly hatched worms, can escape. (6) Web worm (*Hyphantria cunea*) is a caterpillar similar in habits to the preceding, but enclosing the foliage upon which it feeds inside a web until nearly full grown, when like the former species the larvæ disperse. The eggs are laid by a moth in late spring upon the undersides of leaves near the tips of branches of many trees, bushes and even clover. Cutting and burning is the most effective remedy. (7) The round-headed and the flat-headed borers are serious pests. They bore in the young wood, the latter mainly near the ground in the trunk, the former more frequently in the larger limbs. They are the larvæ of two beetles (respectively, *Saperda candida* and *Chrysobothris femorata*). Their presence is indicated by the presence of chip-like castings at the mouths of their burrows. The only effective means of control are cutting out the larvæ or prodding them to death in their burrows with a flexible wire. The application of repellants to prevent the laying of eggs upon the trunks is sometimes recommended. (8) Woolly aphis (*Schizoneura lanigera*) often called American blight in England and Australia, is a serious pest, especially

upon young trees. Two forms of this insect appear; one above ground, the other upon the roots. The former, readily recognized by its woolly appearance, is easily controlled by kerosene emulsion; the latter is hard to fight without injuring the trees. Tobacco dust worked into the ground seems to be the most effective and least harmful remedy. Nursery stock should always be carefully examined for this pest and treated, if necessary, before being planted. (9) Bud moth (*Tmetocera ocellana*), a tiny insect, the larvæ of which appear in midsummer, pass the winter in the larval state and attack the opening buds and young leaves, over which they weave a little web in early spring, when they are most destructive. Paris green is effective. (10) *Aphis fomi*, the green-apple leaf aphis, which injures the leaves of young trees and stunts the growth of the fruit. It can be controlled by spraying with lime-sulphur solution in February or March, and by various insecticides, especially nicotine solutions, later on. (11) Various caterpillars, especially the tent caterpillar, that of the gipsy-moth and that of the brown-tail moth (qq.v.). The methods of controlling these insects are treated under their respective names. The caterpillars of *Tmetocera ocellana* and *Eccopsis nalana* attack the flower-buds. (12) The pear thrips also attacks the blossoms. (13) The plum curculix *Conotrachelus nenuphar*, attacks the fruit, and is controllable by the same methods as the codlin moth. (14) The green-fruit worm, *Xyliner*, eats a cavity out of the side of the apple. See INSECTICIDE.

Protection from Mice and Rabbits.— Wherever mice and rabbits exist they are liable to do much damage to young trees during the winter months, especially when the ground is covered with snow. Anything that affords protection to mice, such as grass, weeds or leaves, should be removed from around the trunks of trees. It is only when the natural food of the rabbit is cut off by being covered with snow that this destructive little animal is forced to resort to gnawing the bark from fruit trees. To prevent this pest from doing this damage, the most effective plan is to tie some material around the body of the tree to the height of two feet or more. Cornstalks cut to the desired length serve the purpose well; building paper, plain or tarred, and even old newspapers are effective.

Diseases.— Apple scab (*Fusicladium dendriticum*) is probably the most serious apple disease, since it causes the loss of much fruit and injures the appearance of much more. It appears as black spots with grayish borders on apples and pears, commonly seen on greening, snow, and yellow harvest varieties that have not been sprayed. Often the abundance of the confluent spots prevents the normal development of the fruit, which becomes lop-sided. The leaves are also attacked, but the markings are not so pronounced. Spraying with Bordeaux mixture is very effective. Rust (*Ræstelia pirata*) appears upon the foliage in early summer as orange spots more or less confluent. The fruit is also destroyed. The spores of this fungus will not germinate upon the apple but find a congenial host in the juniper or cedar, upon which they are called cedar apples (botanically, *Gymnosporangium macropus*). These, when matured in the following spring, look something like orange yellow sponge. Their spores will not germinate upon the cedar, but will upon the apple. Sometimes the fungus perpetuates itself by its mycelium, which may live from year to year upon the young twigs and buds of the apple. Destruction of the cedars and spraying are effective. Apple canker (*Nectria ditissima*) destroys the bark and younger wood, and eventually the tree, but small areas may be cut out and the wounds painted with Bordeaux mixture. In fact, since this disease gains entrance through wounds, all such should be similarly treated. Burning badly infested trees is the only means of checking the spread of this disease. Powdery mildew (*Podosphæra oxycanthæ*), a grayish growth upon the foliage, is often troublesome in the South upon young trees and seedlings in the nursery. It may readily be controlled by a standard fungicide. Bitter rot (*Glomorella rufomasulans*) appears upon the fruit as brown spots extending until they often involve the whole apple. It may attack at any time and is especially destructive to the early varieties, more in the South than in the North. Black rot (*Sphæropsis malorum*) resembles bitter rot and is similarly controlled. Two important bacterial pests are pear blight (*Bacillus amylavorus*), which causes cankers on the limbs and trunks, and crown-gall (*Bacterium tumifaciens*), causing swellings on the trunk and roots just below the surface of the ground. Oregon canker is *Neofabræn malicorticis*. See FUNGICIDE.

Harvesting, etc.— As the fruit ripens, the starch which it contains becomes changed into sugar, the leaf green is replaced by tints characteristic of the variety, the flow of sap into the fruit diminishes until the apple has attained full size and weight, when the flow practically ceases. Since the changes that now take place are mainly chemical and continue independent of the tree, the fruit may be picked. Fruit-growers agree upon this time, which they determine with each variety from experience. The fruits are still hard, but have brown seeds, and, having reached the development mentioned, may be picked by slightly twisting the stem without danger of breaking the twig upon which it is borne, thus preventing a loss of bearing-wood. Fruits gathered at this time and ripened properly are superior to those allowed to hang longer upon the tree. For best results in keeping, apples should be stored as soon as possible after picking; the temperature kept uniform and near 33° F., so as to check the ripening process; draughts avoided, since they hasten decay and increase shriveling, hence closed packages are better than shelves; odors should be excluded.

By-Products.— Apple culls may be used in more ways than the culls of any other fruit crop, and each product finds a ready market, mainly at home. The better specimens are usually evaporated, the cores and peelings of such being utilized either for cider-making or more frequently they are dried and shipped to Europe for the manufacture of certain kinds of champagne and other wines. The others are usually made into cider, which in turn may be remanufactured into jelly, apple-jack (apple brandy, a distilled liquor) or vinegar. When cider and apples are mixed and boiled with or without sugar the product is called marma-

lade, and, if spices be added, apple butter. The pomace (as crushed fruit is called, especially after the expression of the juice) is washed to obtain the seeds, which are dried and used for planting.

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APPLE BRANDY, or APPLE JACK, a liquor made from the fermented juice of apples by ordinary processes of distillation.

APPLE OF DISCORD, according to Greek mythology, the golden fruit thrown among the Olympian divinities by the goddess of discord (Eris), bearing the inscription "for the fairest." Aphroditē (Venus), Hera (Juno), and Pallas (Minerva) became competitors for it, and its award to the first by Paris so inflamed the jealousy and hatred of Hera to all of the Trojan race (to which Paris belonged) that she did not cease her machinations till Troy was destroyed. This story is introduced in Tennyson's 'Œnone.'

APPLE OF SODOM, the title of a fruit described by old writers as externally of fair appearance, but turning to ashes when plucked. It is probably the fruit of *Solanum sodomeum,* a nightshade (q.v.) of northern Africa, which when eaten may produce delirium and even death. An American nightshade is also so called.

APPLE-SHELL, the designation of one of the large, handsomely ornamented, globose, bush-climbing pond-snails of tropical Africa and America, belonging to the genus *Ampullaria.* Some species are to be found along the southern border of the United States. These mollusks are truly amphibious, having both lungs and gills, and are thus able to breathe in water or in air, whenever disposed to exchange an aquatic for a terrestrial existence. Consult Semper, 'Animal Life' (1881).

APPLETON, Charles Edward Cutts Birch, English editor and author: b. Reading, England, 16 March 1841; d. Luxor, Egypt, 1 Feb. 1879. He was graduated from Saint John's College, Oxford, in 1863, studied for two years in German universities, and was appointed lecturer in philosophy at Saint John's College. His best service to literature and his time was his founding the *Academy, a Monthly Record of Literature, Learning, Science, and Art,* whose first number appeared 9 Oct. 1869. Its characteristic feature was the signing of all the critiques and leading articles with the writers' names in full, and these included men of the highest eminence in literature and science. Appleton remained editor until his death. To a volume of essays on the 'Endowment of Research' he contributed two articles: 'Economic Character of Subsidies to Education,' and 'Endowment of Research as a Form of Productive Expenditure' (1876). Consult Appleton and Sayce, 'Life and Literary Relics' (1881).

APPLETON, Daniel, American publisher: b. Haverhill, Mass., 10 Dec. 1785; d. New York city, 27 March 1849. After engaging in the dry-goods business in Haverhill, Boston and New York, he began importing English books with his merchandise. He presently devoted himself exclusively to the business of printing and publishing, and between 1830 and 1849, together with his sons, laid the foundation for the successful career of the American firm D. Appleton & Company. Its publications extend over the entire field of literature, and it has rendered great service in issuing the works of modern scientists at moderate prices; for example, Herbert Spencer, Tyndall, Huxley, Darwin, etc. Medical books form a special department, and Spanish books for the South American market a specialty which the firm has made its own. In *belles-lettres* and American history it has a strong list of names among its authors.

APPLETON, Jesse, American theologian: b. New Ipswich, N. H., 17 Nov. 1772; d. Brunswick, Me., 12 Nov. 1819. After his graduation from Dartmouth College in 1792 he was ordained pastor of the Congregational Church at Hampton, N. H., in 1797. He was president of Bowdoin College, 1807–19. A man of fine culture and attractive personality, he was constantly in demand as a preacher on important occasions. His daughter married President Franklin Pierce. His lectures, sermons and other writings, with a memoir, were published by Prof. A. S. Packard, 'The Works of Jesse Appleton, D.D.' (1837).

APPLETON, John Howard, American scientist: b. Portland, Me., 3 Feb. 1844. He was graduated from Brown University in 1863 and was instructor in chemistry there 1863–89, and full professor 1868–1914 and professor emeritus since 1914. He was a member of the United States Mint Commission 1891. His chemical textbooks have been widely used, and include 'Qualitative Chemical Analysis' (1878); 'Quantitative Chemical Analysis' (1881); 'Chemistry of the Non-Metals' (1884); 'Metals of the Chemist' (1891); 'The Carbon Compounds' (1892).

APPLETON, Nathan, American merchant: b. New Ipswich, N. H., 1779; d. 1861. He started the first cotton power-loom in the United States and was one of the founders of the city of Lowell. He sat several times in the Massachusetts legislature, and in 1830 and again in 1842 was a member of Congress.

APPLETON, Samuel, American merchant, well known as a philanthropist, brother of Nathan Appleton (q.v.): b. New Ipswich, N. H., 1766; d. 1853. He retired from business in 1823 and at his death bequeathed $200,000 for benevolent and scientific purposes.

APPLETON, Thomas Gold, American author and artist: b. Boston, Mass., 31 March 1812; d. New York, 17 April 1884. He was graduated from Harvard University in 1831 and spent much of his life abroad. A generous

patron of the fine arts, he was himself an amateur painter of considerable ability. In society he was a well-known figure, being a brilliant talker with a gift of epigram. His witticism «Good Americans, When They Die, Go to Paris» has been erroneously ascribed to O. W. Holmes and others. His books are 'A Sheaf of Papers' (1874); 'Nile Journal' (1876); 'Chequer Work: Tales and Essays' (1879); 'Syrian Sunshine' (1877); 'Windfalls' (1878). His poem 'Faded Leaves' was once popular. Consult Hale, Susan, 'Life and Letters' (1885).

APPLETON, William Henry, American publisher, the eldest son of Daniel Appleton (q.v.); b. Haverhill, Mass., 27 Jan. 1814; d. 1884. In 1835 he was sent to represent his father's firm in London, and in 1836 a permanent agency was established there. In 1838 he was taken into partnership, and upon the retirement of his father in 1848 he formed a copartnership with his brothers to continue the house of Daniel Appleton & Company.

APPLETON, Wis., city and county-seat of Outagamie County, on the Fox River and the Chicago & N. W. and the Chicago, M. & St. P. railways, 25 miles southwest of Green Bay. It is at the head of navigation on Lake Winnebago and on the Green Bay waterway, on a plateau 70 feet above the river, and near the Grand Chute rapids, which by a series of dams are made navigable for steamboats and with a 50-foot fall supply extensive water power for manufactures. The principal industries are the manufacture of farm implements, furniture, paper, flour, pulp, machinery and woolen and knit goods. The United States census of 1914 reported 108 manufacturing establishments of factory grade, employing 2,576 persons, of whom 2,207 were wage earners, receiving a total of $1,259,000 annually in wages. The capital engaged was $10,261,000 and the year's output was valued at $7,777,000; of this, $2,835,000 was added by manufacture. These figures show an increase over those of 1909 amounting to 15.5 per cent. It is the seat of Appleton Collegiate Institute and Lawrence University (Methodist Episcopal), and has university and public school libraries, three national banks, daily and weekly newspapers and a property valuation of over $3,500,000. The city was settled in 1848, incorporated as a village in 1853 and as a city in 1857. It has adopted the commission form of government. Pop. (1910) 16,773.

APPLIED MECHANICS. Applied mechanics, based on the same laws and principles as theoretical or rational mechanics, nevertheless differs from it in methods of solving problems as well as in the problems themselves. It is the aim in applied mechanics to obtain a faithful representation of the circumstances which condition the state of rest and motion of real, actual systems. It deals therefore with the rational and economic design and construction of structures (bridges, buildings, waterways, etc.) and machines (engines, motors and machinery in general). We no longer meet with the "perfect" fluids, the "perfectly" elastic, rigid, or smooth bodies of theoretical mechanics. Friction, viscosity, plasticity, deviations from the laws of Hooke, Boyle, and Charles are brought into every problem so far as mathematical difficulties and experimental deficiencies will permit. No problem is considered solved until a result is obtained which is verified by experiment and which can be used in making numerical computations. Consider for instance the behavior of a steam engine. The actual steam pressure on the piston varies every instant according to a law compared with which Newton's law of attraction is a model of simplicity; added to that the yielding of the parts, the rubbing of interacting surfaces, the exact rôle of lubricants, the vibrations of the supports, the escape of heat through the cylinder walls, the friction of the steam in passing through the slide valve, and the almost erratic variation of the resistance offered by the machine actuated by the steam engine make what the mathematician terms a «complete solution» hopeless of attainment. Applied mechanics does not attempt the impossible, yet some solution of such problems as this must most urgently be found. But the solution need not be more reliable than the measured experimental data. The precision of engineering data is hardly ever better than 1 per cent and sometimes does not exceed even 10 per cent. Therefore bold approximations and graphical processes will usually give results as precise and correct as, and decidedly more rapid than, those found by analytical methods. Sometimes the conditions which make an analytical solution too difficult to be attempted are neglected; the formulas or results obtained by this simplification — they might be called qualitative as opposed to quantitative solutions — are then compared with experiment and properly modified by means of empirical constants. Thus, the volume of water discharged from an orifice in a tank is calculated on the assumption of steam line flow (see HYDRODYNAMICS); when multiplied by an empirical coefficient it gives the precise discharge and applies also to flow under many different circumstances. Here is the keynote of the science of applied mechanics: Correct and precise results deduced as far as possible from first principles and co-ordinated with experiment. Correctness and precision differ from exactness; a yardstick may be correctly and precisely measured as being one yard long but its exact length may never be known. In physics and engineering "correct" means according to fundamental laws, "precise" means according to measurement. "Exact" implies a finality and absoluteness which science regards as unattainable.

Theoretical mechanics was fully developed early in the 19th century before applied mechanics existed at all. Pioneers like Euler, the Bernoullis, Cauchy, Lagrange, Laplace, Gauss, Poisson, Fourier and Hamilton were primarily mathematicians. They were indeed men capable of building a utilitarian science, but it seems the element of interest was lacking. It is difficult to explain by other reasons why the perturbations in the solar system were worked out before the simple problem of finding the forces in a truss had been solved graphically, or why the analytical theory of heat conduction should have been finished almost a quarter century before thermodynamics was really begun. But it was nevertheless a mathematician who wrote the first systematic treatise on applied mechanics. Isolated problems had of course been studied long before. Galileo had experimented, although unsuccessfully, with

cantilever beams, and Euler, Bernoulli, Coriolis Napier, Smeaton and others had made important contributions to hydraulics and the strength of materials. Poncelet, professor of geometry in Metz, was commissioned by the French Ministry of War in 1824 to found a course in the "science of machines" at the Ecole d'Application. His 'Cours de mécanique appliquée aux machines' appeared in 1826. The mathematician Dupin saw at once that applied mechanics was in itself a science and not merely a collection of isolated applications of theoretical mechanics. He reported to the Academy in 1827:

"It is a production remarkable for the rigor of the mind that developed it [*qui en a tracé la marche*] and for the simplifications made to render less difficult of application to practice those calculations reserved for the most part to transcendental speculations."

Poncelet's work was soon followed by that of others. In 1858 Rankine published the 'Manual of Applied Mechanics' containing his celebrated preface on the 'Harmony of Theory and Practice in Mechanics.' The inclusion of this essay in a textbook is significant in showing that the ancient scholastic contempt for experiment had been completely transformed in the minds of engineers into contempt for what they called "pure theory." To-day, fortunately, the fictitious clash between theory and practice has vanished and to its disappearance must be attributed some of the most valuable contributions, from a utilitarian standpoint, that have been made to engineering science by such mathematician-engineers as St. Venant, Boussinesq and Grashof. Rankine's 'Prime Movers' shortly followed the treatise on mechanics and contained for the first time in an English book the new science of thermodynamics which he and Clausius had developed independently. Willis and Reuleux had meanwhile laid the foundations of the kinematics of mechanism. Applied mechanics thus reached maturity soon after the middle of the 19th century. Still one field, however, remained to be developed: the dynamics of machinery. The necessity of this arose in connection with the balancing and stabilizing of high-speed engines which were now beginning to be introduced. Although investigations along these lines were made from about 1850, by Lechatelier, Villarceau, Résal and Redtenbacher, to the important contribution by Radinger in 1870 ('Dampfmaschinen mit hoher Kolbengeschwindigkeit'), it was left to Yarrow (1892) and Schlick (1893) to make complete application of the new methods. Since then the whole subject of balancing, governing and gyroscopic effect has been exhaustively examined with the aid of the most powerful mathematical analysis. But in spite of its value it has not yet succeeded in displacing in most textbooks a host of academic problems on falling bodies, friction, centroids and moments of inertia.

Applied mechanics is subdivided on pedagogical grounds into KINEMATICS OF MECHANISM; GRAPHICAL STATICS; DYNAMICS OF MACHINERY; STRENGTH OF MATERIALS; HYDRAULICS; THERMODYNAMICS; AERODYNAMICS. These are treated in this Encyclopedia under their respective titles.

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APPOGGIATURA, ą-pŏd'ją-too'rą, a musical term applied to a small additional note of embellishment preceding the note to which it is attached, and taking away from the principal note a portion of its time. It is expressed thus: and performed Long appoggiatura invariably occurs on the beat, and short appoggiatura, now commonly styled a grace-note, is written as an eighth note with a stroke through the stem.

APPOINTING POWER, Military. It has been contended by advocates of executive discretion that army appointments are embraced in the power granted to the President in the section of the Constitution, to nominate and, by and with the advice and consent of the Senate, appoint "all other officers of the United States whose appointments are not herein otherwise provided for and which may be established by law. But the Congress may, by law, vest the appointment of such inferior officers as they think proper in the President alone, in the courts of law, or in the heads of departments." If due regard, however, be paid to the words, "whose appointments are not herein otherwise provided for," the pretension set up in favor of executive power will receive no support from the terms of the Constitution. The powers granted to Congress to *raise* and support armies, and to make all *rules* for the *government and regulation* of the land and naval forces, are necessarily so comprehensive in character as to embrace all means which Congress according to circumstances may deem proper and necessary in order to raise armies, and to govern them when raised. Rules of appointment to office, rules of promotion — another form of appointment — and all rules whatever in relation to the land and naval forces, save the appointment of the commander-in-chief of those united forces, who is designated by the Constitution, are hence within the competency of Congress. It is true that this great power vested in Congress has been exercised, in most cases, by giving to the President a large discretion in appointments and other matters connected with the army. But the principle itself — that supreme command is vested in Congress — has been often asserted in military legislation. Contemporaneously with the foundation of the government, laws have been passed giving to general and other officers the right of appointment to certain offices; in other cases the President has been confined in his selection to classes designated by law; again, rules have been made by Congress for the promotion of officers, and in 1846, an army of volunteers was raised by Congress, the officers of which Congress directed should be appointed according to the laws of the States in which the troops were raised, excepting the general officers, who were to be appointed by the President and the Senate — a clear recognition that the troops thus raised were United States troops and not militia.

APPOINTMENT, the designation of an individual, by the person or persons having authority so to do, to perform the duties of some office or trust. The making out of a commission is conclusive evidence of an appointment to an office for holding which a commis-

sion is required. 1 Cranch (U. S.) 137; 10 Pet. (U. S.) 343. An appointment is usually made by one person or a limited number acting with special authority, while an election is made by all of a class. In chancery practice an appointment is the exercise of a right to designate the person or persons who are to take the use of real estate. 2 Washb. R. P. 302.

APPOINTMENTS, Federal, State and Local. The act of appointing a person to an office or governmental position is complete when the officer or body vested with the legal power has made the selection, or, if the approval of some other authority be necessary, when such authority has sanctioned the selection. To be legal it is not necessary that a certificate of appointment or commission be issued, but this is usually done as a formal evidence of the appointment. There is no exact line of demarcation between an officer and an employee of the government, but a legal distinction is made according to the duties and responsibilities of the position, and to a certain degree this distinction affects the appointment and tenure of office.

FEDERAL APPOINTMENTS.

The Appointing Power.— When framing the Constitution, the Federal Convention of 1787, while vesting "executive power" in the President, did not intend that he should be subjected to the annoyance of making selections of persons for minor positions. Hence Art. II, Sec. II, ¶ 2, provides that the President

"shall have power, by and with the advice and consent of the Senate, to nominate and appoint ambassadors, other public ministers and consuls, judges of the Supreme Court, and all other officers of the United States, whose appointments are not herein otherwise provided for, and shall be established by law; but the Congress may by law vest the appointment of such inferior officers, as they think proper, in the President alone, in the courts of law, or in the heads of the departments."

All three branches of the government — legislative, executive and judicial — exercise the power of appointment to public office, but from the time the first departments were established the heads thereof have made the majority of appointments, since most of the officers are connected with the executive branch of the government. For this reason the executive authority alone is restricted in its power to make appointments. With few exceptions, legislative bodies choose their own officers and employees practically without interference or regulation by either of the other two branches of the government; nor do the other branches, save in a few cases, hinder the independent appointments to subordinate positions connected with the courts that are made by the judicial branch. An executive appointment is usually subject to the approval of some other body.

Appointment of Members of Congress to Office.— Article I, Sec. VI, ¶ 2 of the Constitution provides that "no Senator or Representative shall, during the time for which he was elected, be appointed to any civic office under the authority of the United States, which shall have been created, or the emoluments whereof shall have been increased, during such time; and no person, holding any office under the United States, shall be a member of either House during his continuance in office." With regard to the first clause of this paragraph there has been some dispute, though its significance is apparent. Some have questioned the right of a Senator, who was appointed to a Cabinet position, to receive the increased emolument of the new office if the salary of the Cabinet officers had been increased during the time for which the Senator was elected, but such a Senator is not held to be ineligible to the Cabinet position if he surrender voluntarily the increase of salary. The last clause evidently was intended to make a sharp distinction between the legislative and executive branches, but it has been necessary to define the word office. Accordingly the House judiciary committee has decided that members of commissions appointed for purposes of investigation but which possess or exercise no legislative, executive or judicial powers are not officers of the government within the meaning of this clause; nor can a contractor under the government be disqualified from serving as a member. A distinction has been made also "between the performance of paid services for the executive, like temporary service as assistant United States attorney, and the acceptance of an incompatible office." There is also a distinction between a member and a member-elect, the latter possessing the right until Congress meets to choose between the seat and an incompatible office. On the other hand, persons holding commissions in the army and an officer in the militia of the District of Columbia are considered ineligible.

History of the Appointing Power.— Up to the administration of President Jackson (q.v.) in 1829, there was comparatively little abuse of the power to make appointments to Federal offices either for personal or partisan purposes. The President assumed responsibility for his appointees, endeavored to make appointments from all parts of the country so that no section would feel slighted, and after 1793 usually made his selections from among the adherents of the dominant party, keeping the fitness of the appointee constantly in mind. But there were some attempts to gain a partisan advantage by use of the appointing power, such as Adams' appointment of the "Midnight Judges" and Jefferson's removals and appointments with the object of securing a more even balance between the parties in the civil service. The States had become more or less permeated with the spirit of the spoils system, particularly New York, Pennsylvania, Rhode Island and Massachusetts; in New York the Council of Appointment and the Albany Regency (q.v.) held sway for a number of years and finally the Federal service in New York and Pennsylvania became tainted. There was a wholesome distrust of the life-tenure in executive and legislative office with the result that the States began to enact laws substituting a fixed term for tenure during "pleasure" or "good behavior." The influence of these laws was felt in the Federal service, when, in 1820, Congress passed a law known as the "Four Years Law," limiting the tenure of office of the majority of United States officials, such as district attorneys, naval officers, surveyors, collectors of customs and others having the custody of public money. This served as an entering wedge for the introduction of the spoils system, which was used for purely partisan purpose by President Jackson and his successors without serious hindrance until 1871 and has continued in a modi-

fied form since that time. For details of the spoils system, see UNITED STATES — THE NEW DEMOCRACY AND THE SPOILS SYSTEM.

Attempts at reforming the system of appointments were made prior to the Civil War. In 1853 Congress passed an act which graded the clerical positions according to salary and required examinations of applicants before appointment, but as these were merely non-competitive or "pass" examinations and were conducted by boards selected by department heads, the spoils system received no serious check. In 1871 the first reform law was passed as a rider to an appropriation bill, which empowered the President "to prescribe such regulations for the admission of persons into the civil service of the United States as may best promote the efficiency thereof." President Grant appointed a commission, with George William Curtis (q.v.) as its first chairman, which formulated a set of rules for competitive examinations, but these were rendered inoperative by the refusal of Congress to appropriate sufficient money, though in 1877 they were revived for the New York custom house and post-office. On 16 Jan. 1883 the first comprehensive and detailed civil service act became law, and under it the President has power to extend its jurisdiction, so that the competitive system now covers two-thirds of the entire executive civil service of the Federal government. See CIVIL SERVICE REFORM.

STATE AND LOCAL APPOINTMENTS.

State Appointments.— In making appointments most States follow the practices of the Federal government, the major portion of the appointing power being exercised by the governor and the heads of the State departments, though there are a number of officials, elected by the people, who exercise the appointing power absolutely independent of the governor. In most States, the senate must confirm the governor's appointees, and his removals from office are subject to the same restriction. Most States limit the term of office of all the important officials, whether appointive or elective. In Maine, Massachusetts and New Hampshire there is an elective council who confirm appointments. In the Northern States the spoils system developed early, and by 1805 had become the recognized system of appointments to office; in both North and West it still prevails, but the system never gained a strong foothold in the South. The few weak attempts to break its influence in the North have proved unavailing and only six States now have civil service laws that apply to the State service.

Local Appointments.— City and local governments have no uniform system of appointments to office. As first constituted the elective city council had the power of appointment, with the exception of the most important city officials, who were appointed by the governor of the State. Later the mayor was given power to appoint, but his appointments were subject to the approval of the city council or, if the bicameral system (q.v.) were in vogue, to the approval of the upper chamber of the council. The mayor's privilege of appointing his official family is limited also by the large number of elective officials in city governments and by the retention by the city council of the power of appointing department heads and subordinates. In all cities the most important officials are limited in their term of office. Some cities employ the "Brooklyn plan" of holding the mayor responsible by vesting in him unrestricted power of appointment and removal of department heads, and this provision was incorporated in the New York city charter. In cities under commission government, the city council usually possesses the power of appointment. In county, town and village governments all the important officials are elective. More than 200 cities are enforcing civil service laws, and they have been applied to a very few of the largest villages in New York State, but they have not been applied in smaller units save in the police and fire departments of a few Massachusetts towns. See AMBASSADOR; CIVIL SERVICE REFORM; CONGRESS; CONSULAR SERVICE; JUDICIARY; PATRONAGE; SENATE; TENURE OF OFFICE; and the following titles under the general heading UNITED STATES: THE BEGINNINGS OF PARTY ORGANIZATION, THE CABINET OF THE, JUDICIARY OF THE, THE NEW DEMOCRACY AND THE SPOILS SYSTEM, THE PRESIDENT'S OFFICE, THE VICE-PRESIDENCY, THE SPEAKER OF THE HOUSE OF REPRESENTATIVES.

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APPOLD, ăp'ŏld, **John George,** English mechanician and inventor of automatic machinery: b. 1800; d. 5 Aug. 1865. He invented a centrifugal pump, a brake which was used in laying the Atlantic cable, and a process for dressing furs.

APPOMATTOX COURT HOUSE, Va., village 20 miles east of Lynchburg on the Norfolk & Western Railroad. It is the seat of an agricultural school and a government experiment station. It was the scene, 9 April 1865, of General Lee's surrender to General Grant, an event which virtually concluded the American Civil War. Pop. about 500.

APPONYI, Albert, COUNT, Hungarian statesman: b. 1846. He is the son of the Count George Apponyi (q.v.) leader of the Conservative party that opposed the revolutionary movement of 1848, and one time Chief Justice of Hungary. Count Albert was educated at the universities of Vienna and Budapest, entered Parliament in 1872 and became the leader of the Conservative National party. He

joined the Liberals in 1899, was elected President of the Reichstag in 1901, Speaker of the Chamber 1902–04. Seceding from the Liberal party, he reorganized the National party in 1904, and was Minister of Public Education from 1906 to 1910. Beyond these few years of office, he spent nearly the whole of his parliamentary career in opposition. Together with Andrassy he led the coalition which drove Count Stephen Tisza, the pro-German "Iron Man" from office in 1905. As a delegate to the World Peace Conference at Saint Louis he visited the United States in 1904. He made another trip to this country in 1911, when he delivered some lectures on International Peace. Count Apponyi is undoubtedly the greatest figure in Hungarian politics, an orator, statesman and born leader of men. His remarkable eloquence is of the soothing yet compelling type; in some of the stormy scenes enacted in the Hungarian Parliament, when strong words, ink-bottles and fisticuffs rent the air, the masterful presence and dignified language of Count Apponyi rarely failed to restore peace and order. Intensely patriotic and absolutely honest, he can hardly be said to have found adequate opportunities to test his administrative abilities. His real strength lies in opposition, to rouse men to lofty ideals and to create enthusiasm. He is a voluminous writer and a clever linguist, able to "switch off" into half-a-dozen languages with astonishing ease. Though his political career has been many-sided, abounding in fluctuations and party vacillations, the purity of his life and motives has never been challenged. Like his colleague Count Andrassy, he has contributed numerous articles, mainly on questions of Hungarian public law, in native and foreign magazines. He published 'Æsthetics and Politics: the Artist and the Statesman' (1905), and 'A brief sketch of the Hungarian Constitution and of the relation between Austria and Hungary' (1908).

APPONYI, ŏp'pō-nyĭ, **György (George),** COUNT, Hungarian statesman: b. 1808; d. 1899. He was Hungarian Court Chancellor in 1847. He was leader of the Conservative party, and opposed the revolutionary movement of 1848–49. After some years of retirement he entered the Reichsrath of Vienna in 1859 and was active in furthering schemes for the welfare of Hungary, materially assisting in bringing about the union of Austria-Hungary on the present basis. As Royal Commissioner he opened the Diet at Budapest in 1861 and presided over the Upper House. He was especially successful in restoring the Constitution of Hungary.

APPORTIONMENT, a term signifying the division or distribution of a subject matter in proportionate parts. In relation to contracts an apportionment is the allowance, in case of the partial performance of a contract, of a proportionate part of what the party would have received as a recompense for the entire performance of the contract. But where the contract is to complete a thing for a certain sum of money or other consideration, there can be no apportionment.

Apportionment-incumbrances.— The determining of the amounts which each of several persons interested in an estate shall pay toward the removal or in support of the burden of an incumbrance.

Apportionment-rent.— A term denoting the allotment of shares in a rent to each of several persons owning it. It is also applied to the determination of the amount of rent to be paid when the tenancy is terminated at some period other than one of the regular intervals for the payment of rent.

APPORTIONMENT. National Legislators.— Article I, Sec. III, ¶ I, of the Constitution provides that the United States Senate "shall be composed of two senators from each State," and as provided by Article XVII (adopted in 1913) these senators shall be elected for six years by the direct vote of the people of each State. Article I, Sec. II, ¶ 1–3, provides that the members of the House of Representatives shall be chosen every second year, and the number shall not exceed one for every 30,000, though every State must have at least one representative. Hence the number of members of the lower House varies with the population. When the Constitutional Convention of 1787 debated the question of representation the delegates of the small States insisted on an equal representation of the States as such in Congress, while the delegates from the large States advocated making population the basis of representation. A compromise was effected whereby all the States were to have equal representation in the Senate, the members being chosen by the State legislatures, and the members of the lower House were to be chosen by the people and apportioned according to population. For many years the question of electing Senators by the direct vote of the people agitated the country and finally in 1913 the 17th Amendment was passed. See CONSTITUTION OF THE UNITED STATES.

Having decided that the basis of membership should be one for every 30,000, the Convention guessed at the relative population of the States and divided the 65 members among them. A question then arose as to whether the number of members should be ascertained by dividing the whole population of the country by 30,000 or by dividing the population of each State separately by 30,000 and adding the quotients. The latter method was adopted and pursued for 50 years, no attention being paid to fractions of population. In 1840, the population having grown enormously, the ratio was placed at 70,680 and each State was allotted as many representatives as its population would contain the ratio, with an additional representative if there remained a fraction of more than one-half the divisor. In 1853 another change was made. The whole number of representatives was first determined and the ratio ascertained by dividing the whole population by that number; the population of each State was then divided by the ratio and the quotient represented the number of members for the State. If this did not make the total number of representatives agreed upon, the number lacking was divided among the States having the largest fractional remainders. Hence it sometimes happened that a representative was allowed to a State that did not have a remainder of one-half, while at other times States that had remainders of more than one-half failed

to receive an extra member; occasionally the number of representatives of one State would be decreased by an increase of one in the size of the House. In 1910 a method introduced assumed that the divisor was a continuous quantity between certain limits, that is, subject to slight indefinite changes or increments. It would be easy to determine the critical points at which the decimal part of the quotient for each State passes one-half and divisors were selected midway between each two critical points. Thus a series of tables was obtained under which each one apportioned one more representative than its predecessor and one representative for every major fraction, the minor fractions being disregarded. As decided at various times the ratio of population to each representative has been as follows:

Census	Date of Apportionment Act	States	Members	Ratio
	Constitution 1789	13	65	30,000
1790	14 Apr. 1792	15	105	33,000
1800	14 Jan. 1802	16	141	33,000
1810	21 Dec. 1811	17	181	35,000
1820	7 Mar. 1822	24	213	40,000
1830	22 May 1832	24	240	47,700
1840	25 June 1842	26	223	70,680
1850	23 May 1850	32	234	93,423
1860	23 May 1860	34	243	127,381
1870	2 Feb. 1872	37	293	131,425
1880	25 Feb. 1882	38	325	151,911
1890	7 Feb. 1891	44	356	173,901
1900	16 Jan. 1901	45	386	194,182
1910	8 Aug. 1911	46	433	211,877

Oftentimes after an apportionment has been made a new State or States have been admitted and they are allowed one representative until the next apportionment. Hence, while the Apportionment Act of 8 Aug. 1911 provided for 433 members, the admission of Arizona and New Mexico raised the membership to 435.

Under the Constitution the States were to be represented according to their respective members, but only three-fifths of the slaves were to be counted. Accordingly the whites of the South had a greater proportional representation than the Northern whites, but the total population of the South had less representation than the total population of the North. When slavery was abolished the question of representation again arose and the 14th Amendment was passed providing that if the right to vote in any State were abridged "the basis of representation therein shall be reduced in the proportion which the number of such male citizens shall bear to the whole number of male citizens 21 years of age in the State." Thus if a State should allow full negro suffrage it should have full representation, but under the terms of the 15th Amendment, which soon followed, the States could not limit the suffrage because of race, color or previous condition of servitude. All States have full representation, albeit some do restrict the suffrage for reasons other than those specified in the amendment (such as educational limitations). See ELECTORAL QUALIFICATIONS.

When the apportionment has been made by Congress it is the business of the State legislature to lay out the State in districts for the election of Congressmen. These districts must be contiguous and compact and as nearly equal in population as possible. In arranging these districts the dominant party by combinations of various kinds and unworthy scheming and trickery so maps the State that their opponents are in a hopeless minority at the polls. Such methods are known as the "gerrymander" (q.v.), the "shoe string" or the "saddle bag." If a State has not been divided into districts all the Congressmen are elected by general ticket, which is also the case if Congress has reduced the representation. If there be an increase of representatives and the State be not redistricted before election, the additional members are chosen by general ticket. See CONGRESS; HOUSE OF REPRESENTATIVES; SENATE OF THE UNITED STATES.

State Legislators.— In most States the county is the unit of representation, though in a few of the older States the township is the unit. Some States require that county lines be considered in arranging the legislative districts and while this holds true in New York, a county may be divided into two or more districts. The endeavor is usually made to equalize the population of districts, but some of the States still retain the original privileges of their local areas, thus causing great inequalities in population. In some States each county is limited to one senator regardless of population, while in Rhode Island each town has a senator and one only, so that Providence has no more voice in the upper branch of the State legislature than a small village. In Massachusetts the numerical system has been fully adopted. In some of the States with cities of enormous population, the constitutions have placed restrictions on the power these cities may exert in the legislature; for instance, New York city may never elect more than one-third of the members of the legislature. Such a restriction obtains in Pennsylvania. The legislature usually divides the State, but in some States (as New York and Michigan) the legislature only indicates the senatorial districts, leaving the establishment of assembly districts to the local authorities. There are great differences in the States regarding the methods and details of legislative apportionment. In Illinois minority representation is in use. There senatorial and assembly districts are identical, one senator and three assemblymen representing each district. Each voter has three votes for members of the assembly.

Municipal Legislators.— The State controls city government in varying degrees and in diverse particulars. Most cities, under charters granted by the States, have a mayor and council, elected by popular vote, the first representing the administrative branch of the government and the latter the legislative. The majority of the councils consist of a single body elected by wards or districts usually for one or two years. In some cities there is a bicameral council, the members of one branch being elected by districts, one member to each, while the members of the smaller branch are elected by the whole city or by larger districts. The districts or wards are usually determined by city officials and there too gerrymandering plays its part as well as in State or national politics. Under the commission form of government there is no question of appointment

since the commissioners are elected at large and are presided over by the mayor, who is one of their number. These men constitute the executive and legislative branches of government combined, pass all ordinances, handle the city funds, and hence centralize in themselves all legislative and administrative powers, the members apportioning among themselves the headship of the main administrative departments. See MUNICIPAL GOVERNMENT; COMMISSION GOVERNMENT; BICAMERAL SYSTEM. Consult Ashley, R. L., 'The American Federal State' (New York 1908); Beard, C. A., 'American City Government' (New York 1912); Bruère and Shepardson, 'The New City Government' (New York 1912); Bryce, James, 'The American Commonwealth' (4th ed., London 1910); Fairlie, J. A., 'Essays in Municipal Administration' (New York 1910); Goodnow, F. J., 'Municipal Government' (New York 1910); Hart, A. B., 'Actual Government' (New York 1903); Hinsdale, B. A., 'The American Government, National and State' (4th ed., New York 1905); Munro, W. B., 'City Government by Commission' (New York 1913) and 'Principles and Methods of Municipal Administration' (New York 1916); Reinsch, P. S., 'American Legislatures and Legislative Methods' (New York 1907).

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Ratios under Constitution and at each Census, 1790 to 1910, by States

STATE	RATIOS UNDER CONSTITUTION AND CENSUSES													
	Constitution	1790	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910
	30,000	33,000	33,000	35,000	40,000	47,700	70,680	93,423	127,381	131,425	151,911	173,901	194,182	211,877
	Representation													
Alabama				1	3	5	7	7	6	8	8	9	9	10
Arizona														1
Arkansas						1	1	2	3	4	5	6	7	7
California							2	2	3	4	6	7	8	11
Colorado										1	1	2	3	4
Connecticut	5	7	7	7	6	6	4	4	4	4	4	4	5	5
Delaware	1	1	1	2	1	1	1	1	1	1	1	1	1	1
Florida							1	1	1	2	2	2	2	4
Georgia	3	2	4	6	7	9	8	8	7	9	10	11	11	12
Idaho											1	1	1	2
Illinois				1	1	3	7	9	14	19	20	22	25	27
Indiana				1	3	7	10	11	11	13	13	13	13	13
Iowa							2	2	6	9	11	11	11	11
Kansas									1	3	7	8	8	8
Kentucky		2	6	10	12	13	10	10	9	10	11	11	11	11
Louisiana				1	3	3	4	4	5	6	6	6	7	8
Maine				*7	7	8	7	6	5	5	4	4	4	4
Maryland	6	8	9	9	9	8	6	6	5	6	6	6	6	6
Massachusetts	8	14	17	13	13	12	10	11	10	11	12	13	14	16
Michigan						1	3	4	6	9	11	12	12	13
Minnesota								2	2	3	5	7	9	10
Mississippi				1	1	2	4	5	5	6	7	7	8	8
Missouri					1	2	5	7	9	13	14	15	16	16
Montana											1	1	1	2
Nebraska									1	1	3	6	6	6
Nevada									1	1	1	1	1	1
New Hampshire	3	4	5	6	6	5	4	3	3	3	2	2	2	2
New Jersey	4	5	6	6	6	6	5	5	5	7	7	8	10	12
New Mexico														1
New York	6	10	17	27	34	40	34	33	31	33	34	34	37	43
North Carolina	5	10	12	13	13	13	9	8	7	8	9	9	10	10
North Dakota											1	1	2	3
Ohio			1	6	14	19	21	21	19	20	21	21	21	22
Oklahoma														8
Oregon								1	1	1	1	2	2	3
Pennsylvania	8	13	18	23	26	28	24	25	24	27	28	30	32	36
Rhode Island	1	2	2	2	2	2	2	2	2	2	2	2	2	3
South Carolina	5	6	8	9	9	9	7	6	4	5	7	7	7	7
South Dakota											2	2	2	3
Tennessee		1	3	6	9	13	11	10	8	10	10	10	10	10
Texas							2	2	4	6	11	13	16	18
Utah												1	1	2
Vermont		2	4	6	5	5	4	3	3	3	2	2	2	2
Virginia	10	19	22	23	22	21	15	13	11	9	10	10	10	10
Washington											1	2	3	5
West Virginia										3	4	4	5	6
Wisconsin							2	3	6	8	9	10	11	11
Wyoming											1	1	1	1
Total	65	106	142	186	213	242	232	237	243	293	332	357	386	435

* Included in the 20 members originally assigned to Massachusetts, but credited to Maine after its admission as a State 15 Mar. 1820.

APPOSITION, a grammatical term implying the relationship in which one or more nouns or substantive phrases or clauses stand to a noun or pronoun, which they explain without being predicated of it, and with which they agree in case: as Cicero, *the orator*, lived in the 1st century before Christ; the opinion *that a*

severe winter is generally followed by a good summer is a vulgar error.

APPRAISEMENT, a formal valuation of property, according to legal requirements, or by agreement between the parties interested. Official appraisements in legal proceedings are usually performed according to statute; the principal cases where such appraisals are ordered are in the case of goods subject to duty, the personal estate of a decedent, of property taken over by government or other authorities by right of eminent domain, etc. Unofficial appraisements take place by agreement of the parties interested, such as in the case of insured property which has been partially or totally destroyed. See CUSTOMS; TARIFF LAWS.

APPREHENSION (Latin *apprehensio,* from *ad* + *prehendere,* to seize), a term employed to denote the subjective character of perception. In the philosophy of Aristotle the act of attaining direct acquaintance with any truth or object of knowledge was called *θιγεῖν,* which figuratively means a touching or immediate contact with truth. The scholastics translated this term by the word apprehension, which has descended with modified and extended meaning to modern philosophy. This word has accordingly been employed to designate the act or faculty (1) of perceiving anything through the senses, (2) of forming an image in imagination, (3) of conceiving without judging, the so-called simple apprehension of nominalistic logic; or (4) a relatively simple and immediate act of intellection with or without reference to an external object. In this use of the word it distinguishes this form of intellection from the more complex and elaborated forms of knowledge denoted by the words comprehension, judgment, etc. Thus, for example, when an object or event is viewed apart from other things or events, it is said to be apprehended. When brought into systematic relations with kindred objects of knowledge we say it is comprehended. Stone makes a rather important distinction between implicit and explicit apprehension. Through frequent recognition of an object of knowledge the mind acquires the ability to distinguish and identify it as a whole without apprehending any of its constituent elements. The act which thus grasps its object without conscious combination or synthesis of parts is an implicit apprehension. If attention lingers upon the object, a tendency toward multiplicity arises, the component parts become discernible, and implicit apprehension becomes explicit. In the one there is a distinctionless unity; in the other a conscious synthesis. Implicit apprehension is a form of what Professor Ladd calls the condensation of a series and is an important aim and result of correct mental training.

Wundt distinguishes apprehension from apperception, or what we should call clear and self-conscious perception, in a very suggestive though highly figurative way. He, of course, recognizes that in a series of temporarily successive ideas or mental states the one immediately present in perception has the most favorable position as regards clearness and distinctness. Likewise, in a spatial series, or in a complex of simultaneously interconnected factors present in consciousness, some factors are more favorably located than others. There is, accordingly, a state of clearest grasp in consciousness, which, when accompanied by a special feeling, is called attention. This state of clearest grasp is figuratively styled the fixation point of consciousness, or, more briefly, the inner fixation point. In contrast the whole complex psychical content is called the field of consciousness. A conscious process which passes into an unconscious state is said to pass below the threshold of consciousness. A psychical compound which enters the field of consciousness passes on to the inner fixation point, then out again into the field, and finally descends below the threshold, is an apperceived compound. But just as such compounds may enter the field of consciousness before reaching the point of fixation, so may other compounds enter the field and pass out again without entering the fixation point at all. Such compounds are only apprehended. Thus it appears that Wundt's distinction between apprehension and apperception is simply one of relative clearness and distinctness of perception. Perceptions that are vague and unclear are called apprehensions, while those which are clear, self-conscious and voluntary are apperceptions. Consult Wundt, 'Outlines of Psychology' (Leipzig 1907); Stout, 'Analytical Psychology' (London 1909); Titchener, E. B., 'Textbook of Psychology' (New York 1910).

APPRENTICESHIP, in law, a contract by which a person called a master, who understands some art, trade or business, undertakes to teach the same to another person, commonly a minor, and called the apprentice, who, on his part, is bound to serve the master, during a definite period of time, in such art, trade or business. At common law an infant may bind himself apprentice by indenture, because it is for his benefit. But this contract, on account of its liability to abuse, has been regulated by statute in the United States, and is not binding upon the infant unless entered into by him with the consent of the parent or guardian, or by the parent or guardian for him, with his consent. The contract need not specify the particular trade to be taught, but is sufficient if it be a contract to teach such manual occupation or branch of business as shall be found best suited to the genius or capacity of the apprentice. This contract must generally be entered into by indenture or deed. The contract is to continue, if the apprentice be a male, only during minority, and if a female only until she arrives at the age of 18. The duties of the master are to instruct the apprentice by teaching him the knowledge of the art which he had undertaken to teach him, though he will be excused for not making a good workman if the apprentice is incapable of learning the trade, the burden of proving which is on the master. Ordinarily the indenture should contain, among other things, a stipulation that the apprentice shall be taught the general rules of arithmetic. The master must not abuse his authority, either by bad treatment or by subjecting his apprentice to menial employments unconnected with the business he has to learn; but he may correct him with moderation for negligence and misbehavior. He cannot dismiss his apprentice except by consent of all the parties to the

indenture. He cannot remove the apprentice out of the State under the laws of which he was apprenticed unless such removal is provided for in the contract or may be implied in its nature; and if he do so remove him the contract ceases to be obligatory. An infant apprentice is not capable in law of consenting to his own discharge. After the apprenticeship is at an end the master cannot retain the apprentice on the ground that he has not fulfilled his contract, unless specially authorized by statute. An apprentice is bound to obey his master in all his lawful commands, take care of his property, promote his interests, endeavor to learn his trade or business and perform all the covenants in his indenture not contrary to law. He must not leave his master's service during the term of the apprenticeship. If, without the knowledge or consent of the master, an apprentice is employed by a third person, the master is entitled to all his earnings, whether the person who employed him did or did not know that he was an apprentice. In an action for harboring or enticing away an apprentice it must be shown that the defendant had a knowledge of the apprenticeship. The enlistment of an apprentice in the military service dissolves the relation of master and servant, and the master has no claim to the bounty money or pay of the apprentice so enlisted. A master cannot delegate to another the power to chastise his apprentice, as his authority is a personal one. At common law an apprenticeship is a relation which cannot be assigned, but if under such an assignment the apprentice continue with his new master with the consent of all the parties and his own, it will be construed as a continuation of the old apprenticeship. Consult «Apprentices» (in 'Corpus Juris,' Vol. IV, pp. 1412–54, New York 1914).

APPROACHES, Military. The successors of Vauban followed up, as far as practicable, the methodical stages in conducting the attack founded upon his long experience, and which consisted in a single or a double connected attack: approaching the points assailed by as many lines of communication, directed upon them, as circumstances seemed to demand, and protecting these approaches by three continuous main lines of trenches, termed the parallels, and several portions of parallels, termed demi-parallels, placed between the second and third parallels, all of them very carefully placed so as to be in good tactical relations to one another.

The approaches were usually run in zigzag directions toward the salients of the defenses, crossing the lines of the capitals of these salients, the front of each approach gradually contracting as it was advanced toward the salient, and each boyau of the approach receiving such a direction as not to expose it to an enfilading fire from any point of the defenses within cannon-range. In addition to the communications between the parallels, two or more lines of approaches were run, from the positions selected for the depots of the trenches, to points of the first parallel convenient for the supplies for this and the other lines of works. These were also usually run in the direction of the capitals of some two or more of the salients.

Besides giving the boyaux directions unfavorable to an enfilading fire from the defenses, each one is extended some 12 or 13 yards back, to the rear of the one behind it, so that should the besieged endeavor to take up a temporary position, exterior to his main defenses, each boyau would still be covered by the portion of the one in advance of it run to the rear, not only from an enfilading but from any slant reverse views, except from points so far beyond the defenses as to make their temporary occupation very perilous to the besieged, from their exposure to open assaults.

The positions given to the approaches along the capitals are not obligatory; but will generally be found to offer more advantages than any other that could be given them on ground entirely unobstructed. In the first place, the capitals are the shortest lines from the parallels to the salients of the defenses. In the second, running the boyaux across the capitals, and gradually diminishing the extent of their front, the entire approach will be better flanked by the fire of the parallel in its rear; will be in a position to receive but little if any of the fire which is delivered from the two faces of the salient upon which it is run; will be out of the line of fire of the batteries enfilading these two faces; and will usually be in the most favorable position to defile each boyau from the fire of the besieged.

The front occupied by each approach will depend upon the length given to each boyau. As a general rule, the boyau should not receive a greater length than 100 yards, in order not to expose too long a line to tempt the besieged to enfilade it, and the approach may be started at the first parallel with a front of 60 yards, which should be gradually narrowed, so as to have a front of about 30 yards at the position of the third parallel.

Prior to the great European War, one of the most tremendous combinations of approaches in the history of war was at the siege of Sebastopol. It comprised the digging of no less than 70 miles of sunken trench, and the employment of 60,000 fascines, 80,000 gabions and 1,000,000 sand-bags to protect the men working in the trenches and at batteries. See SIEGE.

APPROPRIATION, a term denoting a specific sum set apart by the legislative power for a designated purpose. In the United States no money can be drawn from the Treasury excepting by appropriations made by law (Constitution, Art. 1). See APPROPRIATIONS, AMERICAN SYSTEM OF.

Appropriation of payments refers to the application of a payment made to a creditor by his debtor, to one or more of several debts. The debtor has the first right of appropriation. No precise words are required of him, his intention when made known being sufficient, but such facts must be proved as will lead a jury to infer that he did intend to make the specific appropriation claimed. An entry made by the debtor in his own book at the time of payment is an appropriation if made known to the creditor, but otherwise if not made known to him. The same rule applies to a creditor's entry communicated to his debtor. If the debtor does not apply the payment, the creditor may do so. There are, however, some restrictions upon this right. The debtor must have known

and waived his right to appropriate. Hence an agent cannot always apply his principal's payment. He cannot, upon receipt of money due his principal, apply the funds to debts due himself as agent, selecting those barred by the statute of limitations. A creditor having several demands may apply the payments to a debt not secured by sureties, where other rules do not prohibit it. The court will direct the application of a payment upon the failure of both debtor and creditor to do so. Payments made on account are first to be applied to the interest due thereon at the time of payment, and if the payment exceed the amount of interest, the balance goes to extinguish the principal. 3 Sandf. Ch. (N. Y.) 608; 11 Paige Ch. (N. Y.) 619. Funds must be applied by the creditor to a judgment bearing interest, in preference to an unliquidated account. When no other rules of appropriation intervene, the law applies part-payments to debts in the order of time, discharging the oldest first. The general rule is that neither debtor nor creditor can so apply a payment as to affect the liability of sureties without their consent. Where a principal makes general payments the law presumes them, *prima facie,* to be made upon debts guaranteed by a surety rather than upon others, although circumstances and intent will control this rule, as they do other rules of appropriation. 5 Leigh (Va.) 329. Payments upon continuous accounts are applied to the earliest items of account unless a different intent can be inferred. 5 Metc. (Mass.) 268; 23 Me. 24; 3 Sumn. C. C. 98. Where a creditor of an old firm continues his account with the new firm, payments by the latter will be applied to the old debt, *prima facie,* the preceding rule of continuous accounts guiding the appropriations. A different intent, however, clearly proved, will prevail. The appropriation cannot be changed, when once made, but by common consent, and rendering an account and bringing suit declaring in a particular way is evidence of an appropriation. 9 Paige Ch. (N. Y.) 165.

APPROPRIATIONS, American System of. The Constitution of the United States provides that no money shall be drawn from the treasury except under appropriations made by law (Art. I, Sec. IX, ¶ 7) and that no appropriation for the army shall be made for more than two years (Art. I, Sec. VIII, ¶ 12). In 1789, when the Treasury Department was established, Congress directed the Secretary to prepare estimates of public expenditures, but as explained elsewhere (see BUDGETS, AMERICAN) this is purely a formal duty and the executive estimates (known as the Book of Estimates) merely form a basis from which Congress can formulate the plans for revenues and expenditures. Thus the only manner in which the Executive Department participates in the framing of appropriation bills is through the presidential power of veto, and accordingly the Legislature may be said to have complete control over the expenditure of public funds. The Constitution provides that all bills for raising revenue shall originate in the House of Representatives (Art. I, Sec. VII, ¶ 1), wherefore it was easily assumed that, having the initiative in raising revenues, the House should also have similar control over expenditures. This right has been jealously guarded, but the placing of control of the expenditure of public funds in the hands of Congress has resulted in scattering the responsibility, though this latter evil was not so noticeable when the committee on ways and means had charge of both revenue and appropriation bills. In 1865, however, the task of preparing appropriation bills was taken away from this committee and delegated to a special committee on appropriations. In 1880 and 1885 still more sweeping changes were made, the committee on appropriations being deprived of some of its powers which were given to new committees created to prepare bills for separate departments of administration. These bills were 14 in number, of which the committee on appropriations was to have charge of six, namely: (1) Legislative, executive and judicial; (2) District of Columbia; (3) fortifications; (4) pensions; (5) sundry civil; (6) deficiency. The other appropriation bills with the committees handling them were as follows: (1) Agriculture, committee on agriculture; (2–3) army and military academy, committee on military affairs; (4) diplomatic and consular, committee on foreign affairs; (5) Indian, committee on Indian affairs; (6) naval, committee on naval affairs; (7) post-office, committee on post-office, and (8) rivers and harbors, committee on rivers and harbors. With this divided initiative there is a tendency for each committee to magnify the importance of the work intrusted to it and to attempt log-rolling in an effort to secure as large an appropriation as possible, regardless of the needs or merits of claims of other departments.

Annual Appropriations.— Appropriations are divided into three classes: Annual, permanent specific and permanent annual. The first class is enumerated above. Under an act of 20 June 1874, unexpended balances of appropriations (with few exceptions) remaining in the treasury books for two fiscal years are to be carried to the surplus fund and turned back into the treasury. The exceptions consisted of: (1) Permanent specific appropriations; (2) continuing appropriations such as those for rivers and harbors and public works; (3) pay of the army and navy marine corps, since they often participate in long cruises; (4) claims arising under a treaty with Great Britain and pre-existing contracts. Under the head of permanent specific appropriations come those specifically made for certain definite ends but which remain available until entirely expended, such as appropriations for improving rivers and harbors and the construction of public works. Among the permanent annual appropriations (which do not require annual vote but which rest upon prior enactment of laws) are payments of interest on public debt, the requirements for the sinking fund, refunds and taxes collected through error, salaries of judges and expenses of collecting customs duties. The salary items contained in the regular appropriation bills might properly be classed under the head of permanent annual appropriations, since they are authorized in other statutes. An appropriation bill not only may grant money for a specific and definite object and for a given year, but may authorize the making of contracts that will necessitate expenditures for many years to come. Though the objects of

these future expenditures may be specified and the amounts apparently restricted, the contemplated new works, once begun, may constitute a basis for new demands, the ultimate cost of which cannot be foreseen.

Unless unanimous consent be obtained, new legislation cannot be introduced in an appropriation bill, nor can a general appropriation bill or any amendment thereto carry an expenditure not previously authorized by law. But this rule is elastic since oftentimes an appropriation bill may be passed providing salaries for new clerks or officials in a department whose positions have not previously been sanctioned by Congress; and sometimes the clerical force of a department is reduced or part of a service already established is eliminated. Strictly speaking, the reduction as well as the increase would constitute new legislation. In practice it would be impossible to consider every item which involved an increase or decrease of administrative force or equipment and few objections are made to such items. But occasionally party strife becomes bitter and numerous items are objected to and thrown out. Accordingly in 1906 the House adopted a rule virtually depriving members of the right to object and placing the committee in complete power, subject, of course, to majority vote under the ordinary procedure.

Department Heads and the Deficiency Bills.— While Congress is supposed to control expenditures and appropriations, instances have occurred whereby, through loose practices, a department head has placed Congress in such an embarrassing position that it was really coerced into making appropriations. As Mr. Tawney, chairman of the committee on appropriations, once said: "Many of the Executive Departments proceeded on the theory that they, and not Congress, should fix the standard of public expenditure, and if the amount appropriated for the service under their jurisdiction was not in their judgment adequate, they proceeded to extend the appropriation upon the basis of their estimates, and then, at the next session, would submit deficiency estimates, which, if not allowed, would necessitate the suspension of the service." Accordingly in 1905, in a general appropriation bill, Congress decreed that grants to departments should be apportioned by monthly allotments so as to avoid deficiencies, though this apportionment might be waived by the department head if he stated the reason in writing. But department heads used this privilege so freely that Congress later enacted that the apportionment might be waived only in case of emergency. Sometimes, if appropriations for a department have been reduced and a certain bureau of that department be affected considerably by the reduction, the bureau chief endeavors to secure the funds he had requested by drawing upon the general or permanent fund, which often causes a deficiency. Large amounts are still carried in deficiency bills, in spite of all efforts to harmonize estimates of revenues and expenditures, but this is largely due to legislation that was not contemplated when the regular appropriations were under consideration. There is also lack of harmony between the executive and legislative departments. Sometimes a department head recommends economical changes for the good of the service or the abolition or consolidation of certain customs districts which have no fiscal justification, whereupon fearing a loss of patronage, the Congressman of the district affected attempts to defeat the proposed change. Often Congress is prodigal in its appropriations in spite of executive appeals for economy, in one case the appropriations exceeding by $115,000,000 the estimates submitted by the Secretary of the Treasury. In another instance the departments asked for an increase of 171 employees, but instead of granting the request the appropriations committee reduced the existing number by 61. Hence Congressmen do not know whose recommendations to follow.

Appropriation bills in the Senate receive somewhat different consideration since they do not originate there. Originally the finance committee considered all appropriation bills, but in 1867 all bills except the rivers and harbors bill were taken away and assigned to the new committee on appropriations. But in order to insure harmony, one member of each of the most important committees dealing with general legislation is a member of the committee on appropriations. Through its power of amending House bills the Senate exercises an important influence in determining grants and usually increases appropriations.

The President and Controller.— The President may veto an appropriation bill, but is powerless to reduce it; he must consider the bill as a whole and cannot veto separate items. He is loath to hinder the operations of government because of opposition to appropriations of a certain character and, knowing this, various riders are attached by Congress in the hope of passing the Executive, who perhaps will prefer not to quarrel if the bill as a whole be good. The Controller of the Treasury determines whether Congress has expressly authorized an appropriation, and the appropriation is not finally secure until he has passed upon the warrant for its payment from the treasury. This official may raise technical objections which would prevent the payment of appropriations presumably sanctioned by the necessary authority.

State and Local Appropriations.— General appropriation bills are passed by the legislatures of all but 11 of the States, but these may not include all the money appropriated. New York has a general appropriation bill covering only absolutely necessary expenses; a supply bill which provides for unforeseen expenditures and deficiencies; and a supplementary supply bill at the end of the session to care for all items omitted by the others. There are a large number of separate appropriation bills in Massachusetts. As a rule, State appropriations run for a year and any balances revert to the treasury, but in some States they run for a year after the year for which they were made. In some States the governor has the power to veto items in the appropriation bills; in some States officials have authority to borrow to meet deficiencies in their departments, though the amount and rate of interest are generally limited. No Massachusetts official may incur liabilities greater than the amount appropriated and the commonwealth cannot be held responsible for an excess. In

some States an officer so exceeding his appropriation is held personally liable. In 32 States there is a constitutional limitation on the amount of indebtedness for deficiencies of revenues. In cities appropriation bills may be prepared either by a city council or board of aldermen, or by a board of estimate consisting of executive officials. As a rule mayors may veto separate items. See BUDGETS, AMERICAN—*State and Local.*

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APPROXIMATION, a term in mathematics signifying a continual approach to a quantity required, when no process is known for arriving at it exactly. Although, by such an approximation the exact value of a quantity cannot be discovered, yet in practise it may be found sufficiently correct; thus the diagonal of a square whose sides are represented by unity is $\sqrt{2}$, the exact value of which quantity cannot be obtained; but its approximate value may be substituted in the nicest calculations. This process is the basis of many calculations in pure and applied mathematics and is of frequent use and great importance in all practical operations.

APPURTENANCE, in legal phraseology anything belonging to another thing as principal, and which passes as incident to the principal thing, 10 Pet.(U.S.)25; 1 Serg. & R. (Pa.) 169. For instance, if a house and land be conveyed, everything passes which is necessary to the full enjoyment thereof and which is in use as incident or appurtenant thereto. If a house is blown down, a new one erected there shall have the old oppurtenances. 4 Coke 86. The appurtenances of a ship include whatever is on board of it for the objects of the voyage and adventure in which she is engaged and which belong to her owner.

APRAXIA, a term denoting a loss of power to appreciate the use and nature of common objects. Thus a patient with this affection might try to comb his hair with a toothbrush or blacken his boots with a dinner-plate. It is chiefly due to a cutting off of one brain hemisphere from the other and is thus present in hemorrhage or tumor of the brain, chiefly involving corpus callosum fibres.

APRAXIN, ą-präks'in, **Feodor Matejevitch,** a Russian admiral: b. in 1671; d. in Moscow in 1724. He may be considered as the creator of the Russian navy and was the most powerful and influential person at the court of Peter the Great, who made him chief admiral. In 1708 he defeated the Swedish general Lübecker in Ingermannland and saved the newly-built city of Saint Petersburg from destruction. In 1713 he took Helsingfors and Borgo and defeated the Swedish fleet. He was twice fined for embezzlement, but, being too useful to be dispensed with, Peter in both instances neutralized the effects of the condemnation by conferring upon him additional riches and dignities.

APRAXIN, Stepan Feodorovitch, Russian general, grandson of F. M. Apraxin (q.v.): b. in 1702; d. in 1760. He defeated the army of Frederick the Great at Gross-Jägerndorf in 1757 but, omitting to follow up his victory by proceeding to Berlin, was tried by court-martial but died before sentence was pronounced.

APRICOT, a small tree (*Amygdalus armeniaca*), of the family *Amygdalaceæ*, long grown for its fruit and supposed to be a native of China, whence it reached Europe by way of western Asia in the time of Alexander the Great. The fruit resembles the peach in form, color and its downy skin and has a large smooth or slightly furrowed plum-like pit. It usually ripens earlier than either the peach or the plum. The choice varieties, of which, considering the length of time that it has been in cultivation there are comparatively few, are firmer, less juicy, but probably higher flavored than the peach. The tree is plum-like in leaf and habit and peach-like in bark. The apricot demands practically the same general management and is as hardy as the peach and succeeds in similar climates and situations.

The Russian apricot is a rather hardy race of the common species, with small fruits of generally inferior flavor. The Japanese apricot (*Amygdalus mume*), rather recently introduced into the United States as the Bungoume plum, bears small greenish or yellowish rather hard and dry clingstone fruits. Its flowers are fragrant. The little cultivated black or purple apricot (*Amygdalus dasycarpa*), bears globular plum-like acid clingstone fruits. See GRAFTAGE; ORCHARD.

Eastern Apricot Growing.— Though grown to some extent in the eastern United States the apricot has not become widely popular for four principal reasons: Its susceptibility to injury from late spring frosts which destroy the very early-appearing blossoms; the attacks of its special enemy, the curculio (see PLUM); incomplete knowledge of suitable stocks upon which to work it so as to ensure its most perfect growth in various soils, etc.; and ignorance of its dessert qualities, probably owing to the lack of systematic exploitation by nurserymen. Best results seem to be obtained upon the deep, dry, gravelly loams suited to the apple, where such lands are situated

on the leeward side of large bodies of water or elevated and facing the north. The trees are usually set 20 feet apart and cultivated like the peach but since the fruit-bearing habit is similar to that of both the plum (on spurs) and the peach (on wood of the previous season's growth), pruning resembles most nearly that of the plum. When properly managed and grown under favorable conditions the apricot probably equals the peach in productiveness, but like other tree fruits the fruit must be systematically thinned to obtain specimens of good size and to prevent bearing in alternate years. Since the apricot is even more a dessert fruit than the peach and must be carefully grown, picked, packed and marketed, only the most careful Eastern fruit-growers attempt its extensive cultivation. The chief disease, leaf-spots, is treated under PEACH.

California Apricot Growing.— Though the apricot has been known in California for more than a century in the vicinity of the missions, where it was grown mainly from seeds, it has become commercially important only since American occupancy, in the early years of which improved varieties were introduced from Europe. In the Old World these varieties were trained to walls and otherwise coddled; in California they require no such treatment. As a consequence the apricot has become a leading fruit of the State where now about 40,000 acres are devoted to this crop. The world-wide demand for the fruit, fresh, dried, canned and candied, is fostering still wider planting, and California, already the greatest apricot-growing region of the world, seems destined to be still greater. The tree is found to succeed well on the higher ground of interior valleys upon a variety of soils, but, as in the East, is susceptible in the low ground to injury by late spring frosts. For detailed account of California apricot-growing consult Bailey 'Cyclopedia of American Horticulture' (1914).

APRIL (Latin, *Aprilis*), the fourth month of the year, consisting of 30 days, so-called probably from the word *aperire*, to open, as the buds begin to open at this time of the year. It was called Ooster, or Easter month, by the Anglo-Saxons and Charlemagne, in his new calendar, called it the grass month. In the Roman calendar April was the second month of the year and it was Julius Cæsar who added the 30th day to it; during Nero's reign it was called Neroneus; and in the Athenian calendar it corresponds to the latter portion of Elaphebolion and to the greater part of Munychion. In the French revolutionary calendar, as adopted by a decree of the National Convention on 24 Nov. 1793, it was merged into the last part of Germinal (bud month) and the first part of Floréal (flower month). Thus Germinal corresponds to the period 21 March to 19 April, and Floréal to the period 20 April to 19 May. See CALENDAR; EPOCH.

A PRIORI, a term in logic denoting the negation of a posteriori. To prove anything a priori means to do it on grounds preceding actual experience or independent of it. Mathematical proofs, for example, are a priori. On the contrary, judgments or proofs a posteriori are founded on knowledge before acquired, like the conclusions of natural history and all experimental science. In ordinary speech a thing is said to be proved a priori when deductively derived from a more general principle, even though that principle may itself be derived from experience. This, however, is not the sense which the phrase bears in philosophy. By a priori knowledge Kant, who originated the transcendental method of philosophy, means that which is independent of all experience, such as, in his opinion, the knowledge of the fact that space has three, and no more than three, dimensions. The marks of a prior knowledge, according to that philosopher, are, first, that it is necessarily true, and second, that it is absolutely universal, in the logical sense — that is, true of the whole subject: in the example just given it was Kant's opinion that space not only has, but must have, three dimensions and can have no more; and that this is true of all space and not merely of some spaces. See LOGIC; KANT; DEDUCTION; INDUCTION; EMPIRICISM; TRANSCENDENTALISM; etc.

APSE, an architectural term applied to a semi-circular or polygonal portion of a building, roofed in by itself and most commonly appearing as the eastern termination of a church. The apse is a feature of Roman origin, corresponding to the curved recess in which sat the presiding magistrate and his assessors in the basilica or hall of justice. In front of the apse stood an altar for public sacrifices. When the Christians received the protection of the state in the time of Constantine, basilicas were frequently used for their assemblies, the bishops occupying the seats originally appropriated to the presiding magistrates and the inferior clergy filling the seats of the assessors, the altar still keeping its place. In the cathedrals of France, Germany and Italy the apsidal termination is frequently met with; in England it is less common, but examples are found in Westminster Abbey and the cathedrals of Canterbury, Rochester, Norwich and Peterborough and several parish churches; examples may also be seen in Scotland in the churches of Kirkliston and Dalmeny in Linlithgowshire and of Leuchars in Fifeshire. Transepts with apsidal ends occur on the Continent, while apsidal chapels opening eastwardly from the transepts are found in England in churches of Norman date.

APSIDES, ăp'si-dēz (the plural of *Apse* or *Apsis*), an astronomical term designating the two points in the elliptic orbit of a planet where it is at the greatest and the least distance respectively from the body around which it revolves. The moon moving in an elliptic orbit around the earth, which is situated in one of the foci, is at what was anciently called its higher apse when in apogee and at its lower one when in perigee. Similarly the primary planets, including the earth and some of the comets, moving in elliptic orbits around the sun, which is situated in one of the foci, pass through their higher apse when in aphelion and their lower one when in perihelion. It is the same with the satellites of Jupiter when they are farthest from Jupiter and nearest to it.

The line of the apsides is the line connecting the two apsides of a primary or secondary planet.

The progression of the moon's apsides is a slow movement in the position of the apsides of the moon produced by the perturbing attraction of other heavenly bodies. It is about three degrees of angular motion, in one revolution of the moon and in the same direction as her progression in her orbit. The apsides of the primary planets are also perturbed.

APSLEY STRAIT, a narrow channel between Melville and Bathurst Islands, off the north coast of Australia. It is about 40 miles in length, with a breadth varying from two to five miles. The land is low on either side and the shores bordered by a broad belt of impenetrable mangroves and indented by numerous salt-water creeks, which present the appearance of rivers. Alligators of enormous size abound in the Straits, many of them measuring from 14 to 17 feet in length. A settlement was formed in 1824, on the Melville Island side of the channel, about 8 or 10 miles from its northern entrance, but subsequently abandoned.

APTERYX, a strange flightless bird of New Zealand, representing the *Apteryges,* a group of ratite birds nearly related to the extinct dinornis. Four or five species are known in the various islands of the New Zealand group, besides two fossil species. These curious birds, called "kiwis" by the natives, are about the size of domestic fowl and have very stout legs, wings reduced to a mere useless stump, long snipe-like beaks and no visible tail. The plumage is colored in streaked browns and grays, and the feathers are incomplete, the disunited filaments giving them the appearance and feeling of coarse hairs. Kiwis inhabit the forested hills, going about in small flocks which during the day hide in the thickets or in cavities of the ground or rocks. They sleep during the bright part of the day rolled up into a ball, but sometimes rest for a long period in a standing position, with the point of the bill touching the ground, as though they were leaning upon it. Their feeding-time is in the dusk of early morning and at evening and their diet consists chiefly of worms, which they search for apparently mainly by the sense of smell and obtain by probing the ground with their long bills. The nostrils are at the tip of the beak, which is also flexible and extremely sensitive to the touch, so that a worm may be detected when it is touched, although the bill may need to be thrust its length into the ground. The nest is usually at the end of a round tunnel dug in soft earth by the female and consists of a little dry fern or a few leaves. The eggs, generally two in number and incubated mainly by the male, are remarkable for their size, since they are equal to a quarter of the mother's weight. They are greenish white in color with a smooth surface. As might be expected from the size of the egg, the development of the young reaches a high degree of maturity before hatching. The Maoris are very fond of the flesh of the kiwi, either roasted or boiled, and their persistent hunting had greatly decreased the number of the birds before white men reached the islands. Since that time dogs and other accompaniments of civilization have nearly exterminated these birds, which are the sole survivors of the moas. The most complete description of their habits will be found in Buller's 'Birds of New Zealand' (2d ed., 1888). For anatomical details and relationships consult Parker's memoirs in the 'Philosophical Transactions' for 1891 and 1892. A good summary of this information will be found in Newton's 'Dictionary of Birds' (1896). See DINORNIS; MOA.

APTHORP, William Foster, American dramatic and musical critic: b. Boston, Mass., 24 Oct. 1848; d. 1913. He was graduated from Harvard University in 1869 and pursued his musical studies under J. K. Paine and B. J. Lang. He taught in the New England Conservatory and College of Music to 1884, was musical critic for the *Atlantic Monthly* 1872–76; the Boston *Sunday Courier* 1876–78; and the *Evening Traveler* 1878–80. He was musical and dramatic critic for the Boston *Evening Transcript* for 20 years and was the critical editor of Scribner's 'Cyclopædia of Music and Musicians.' He wrote 'Hector Berlioz' (1879); 'By the Way'; 'Musicians and Music Lovers'; 'The Opera, Past and Present.'

APUKHTIN, ä-pooh'tēn, **Aleksei Nikolayevitch,** Russian man of letters. b. Bolkhov, 15 Nov. 1840; d. 17 Jan. 1893. He descended from an old noble family. A man of extraordinary ability, he, while yet a child, betrayed an astounding memory and a fondness for reading, especially of poetry. While yet under 10 he knew by heart the works of Pushkin and Lermontov. Besides these his favorite poets and authors of later years were Griboyedov, Baratinski, Tyuchev, Fet, A. Tolstoi, L. Tolstoi, Turgenev, Dostoyevski and Ostrovski. In 1852 he entered a law-school from which he was graduated with distinction in 1859. He then entered the civil service as a member of the Ministry of Justice and after two years retirement in the country (1862–64), became associated with the Ministry of the Interior. Because of a chronic disease (obesity), which began developing in his youth, he kept away from society. He spent most of his life in Saint Petersburg. His literary career began while he was yet a student. To his juvenile productions belong 35 poems which due to his self-criticism appeared only in a posthumous edition. His other attempts of childhood ('Epaminondas,' 'Imitation of the Arabic,' 'Ode on the occasion of the birth of the great duchess Vera Konstantinovna') were published in the *Invalid,* 1854–55. His poems of 1859–62 appeared in the periodicals *Sovremennik, Vremya* and *Russkaya Riech.* They met with great success and earned the approval of Turgenev, Nekrassov and Fet. Despite this approval he wrote nothing during 1862–68. His best works belong to the period which followed this pause. At first he did not publish anything. His works of 1868 'Requiem,' 'A Night in the Monastery,' 'Old Love,' and a few others were circulated in manuscript. In 1872 his poem 'The Unfinished Monument' appeared anonymously in *Grazhdanik* (Citizen). Only in 1884 did he begin to contribute to *Viestnik Yevropui, Russkaya Muisl* and *Sievernui Viestnik.* The

first edition of his works appeared in 3,000 copies in 1866. In 1890 he began writing novels. At his request his three novels 'From the Archieves of a Countess' (1890), 'Diary of Pavlik Dolski' (1891) and 'Between Life and Death' (1892) were published posthumously. He was, however, at his best in his poems. His poetry is characterized by sincerity, simplicity, purity and deep feeling. Their form is elaborated with great care. Some of his poems ('Mad Nights') have been set to music. Translations of some of his works ('The Russian Parnassus,' 'Flies,' 'I am not sorry,' 'Old Love') are contained in the collection of Fidler. Criticisms can be found in *Russkaya Muisl* (No. 5, 1886); *Viestnik Yevropui* (Vol. 2); Arsenyev, K. K., 'Critical Studies'; Gogorov K., 'Contemporary Poets'; Vengerov, 'Critical and Biographical Dictionary of Russian Writers and Scholars'; Skabichevski, 'History of Modern Literature.'

APULEIUS, or **APPULEIUS, Lucius,** a satirist and philosopher of the 2d century: b. at Madaura, in Numidia; the time of his death is unknown. He was author of the celebrated satirical romance called the 'Golden Ass.' He first studied at Carthage, then renowned as a school of literature, and afterward went to Athens, where he became an ardent follower of the Platonic philosophy. Falling ill while on a journey he was hospitably received in the house of Sicineus Pontianus, a former fellow-student, whose widowed mother Apuleius married. Soon after Pontianus died, and the relatives of the rich widow publicly accused Apuleius of having used magical arts to gain her love. The speech by which he successfully defended himself 'Apologia sive Oratio de Magia,' is still extant. The remainder of his life, which he devoted to oratory and literature, seems to have been passed at Carthage, where, as in some other cities, a statue was erected in his honor. His 'Metamorphoses,' 'Golden Ass,' a romance in 11 books, contains wit, humor, powerful satire and much poetical merit. It is supposed to have been intended as a satire on the hypocrisy and debauchery of certain orders of priests, on the tricks of pretenders to supernatural powers and on the prevalent vices generally. The finest part of this work is the episode of Psyche, called by Herder the most tender and many-sided of all romances. It is sufficient to render him immortal, even if he be, as some have supposed, only the narrator and not the inventor of the story. Apuleius was also the author of many works on philosophy and rhetoric, some of which are still extant. Cervantes, Le Sage, Boccaccio and others are indebted to Apuleius for various episodes. Consult edition of his complete works, Hildebrand (1842); Van Vliet (1897–1900). An English translation by Head was published in Bohn's Classical Library in 1851. See GOLDEN ASS, THE.

APULIA, province of southern Italy, composed of the provinces of Foggia, Bari and Lecce; area, 8,539 square miles; pop. about 2,000,000. The northern part forms the Apulian Plain, a rather barren tract on the whole, although affording extensive sheep pastures and isolated spots capable of cultivation, on which are wine, olives, southern fruits and maize. The isolated mountain Gargano here attains the height of nearly 5,000 feet. The most important river is the Ofanto (Aufidus). There are four coast-lakes of considerable size. Lake Salsi dries up in a great part in summer, and on its banks are the great salt-boiling works of Barletta. There is a considerable trade in grain, oil, salt; southern fruits, cattle, wool, etc. Apulia was in ancient times inhabited by several peoples, such as the Apuli, Messapii and Daunii. It was subdued by the Romans in 317 B.C.

APURE, ä'poo-rā', river in Venezuela, formed by the junction of several streams issuing from the Sierra de Merida. After an eastern course of about 300 miles it falls into the Orinoco at Capuchino. It is navigable throughout almost its entire course.

APURIMAC, ä-poo'rę-mäk', a highland department of Peru, embracing a territory of 8,187 square miles and lying between the departments of Cuzco and Ayacucho. Its capital is Abancay. It has extensive upland pastures, and the soil, fertile in the main, is watered by the Apurimac River and its tributaries. Agricultural products are cereals, sugar, rice, coffee, maize, potatoes and cocoa. The products of the mines are gold, silver, saltpetre and copper. The provinces are Abancay, Aimaraes, Andahuailas, Antabamba and Cotabambas. Number of inhabitants (1916) 133,000.

APURIMAC, Peruvian river in South America, the outlet of a lake in the Andes of Peru, in the province of Arequipa, not far from Caylloma. It is probably the tributary of the Amazon rising nearest the Pacific Ocean. It flows through a mountainous country in a northerly direction, and, joining the Yucay or Vilcamayu at lat. 9° 15′ S.; long. 72° 30′ W., forms the Ucayale, one of the principal tributaries of the Amazon. Its entire extent is between 500 and 600 miles.

APUS, a name designating a fresh-water phyllopod crustacean, remarkable for having 47 body-segments, 20 being the normal number in *Crustacea.* It also has 60 pairs of limbs. The body is protected by a large carapace resembling that of the king-crab (q.v.) in that it is adapted for burrowing in soft mud at the bottom of lakes or pools. Apus is locally distributed over western North America, Asia and Australia. One form (*Lepidurus gacialis*) lives in pools in the Arctic regions. It undergoes a complete metamorphosis, its larva being a "Nauplius" (q.v.). Consult Packard, 'Monograph of North American Phyllopod Crustacea' (1883); Bernard, 'The Apodidæ' (1892). See PHYLLOPODA. The family (*Apodidæ*) appears to be of great antiquity.

AQUA (Latin, water), a word used by the alchemists and early chemists for solutions or other fluid preparations in which the menstruum is water. *Aqua ammoniæ* ("ammonia water") is an aqueous solution of ammonia gas (NH_3). *Aqua fortis* ("strong water") is nitric acid. *Aqua regia* ("royal water") is a mixture of nitric and hydrochloric acids, the name (bestowed by Basil Valentine) referring to its power of dissolving gold and other so-called noble metals. *Aqua vitæ* ("water of life"), so-called by Avicenna, is common grain alcohol. The word "aqua" is still in general use in pharmacy for designating aqueous solutions or infusions.

AQUADAG. The name of a lubricant whose basal constituent is graphite. It is made by treating graphite with tannin and various plant extracts which reduce it to so fine a state of subdivision that it passes readily through a standard filter paper and remains permanently diffused in water. The treatment by which the graphite is thus reduced to infinitesimal particles is called "deflocculation." The name of the product is formed from the word "aqua," meaning water, and the initial letters of the phrase "deflocculated Acheson-Graphite." This lubricant has the valuable power of preventing the rusting of metal which is immersed in the water carrying the graphite. The benefits of such a product are numerous and practical in the manufacturing world. Patents on the various processes of the manufacture of Aquadag have been taken out in 23 countries, which practically include the whole of the industrial world, and the word itself has also been trade marked in many countries.

AQUÆ SOLIS, the ancient Roman name of the modern English city of Bath. It was famed for the splendor of its buildings and its many springs, and the remains of several Roman baths have been discovered here.

AQUAMARINE, ă-kwą-mą-rēn′ (from the Latin *aqua marina,* "sea water," a bluish-green variety of beryl (q.v.) esteemed as a gem. Siberia and Brazil have long been celebrated localities, while magnificent gem material has lately been mined in North Carolina.

AQUARIANS, a name applied to Christian ascetics in the primitive Church, who consecrated water instead of wine for the celebration of the Lord's Supper — either for the sake of abstinence, or because they thought it unlawful to drink wine.

AQUARIUM (Latin, a watering-place for cattle, from *aqua,* water), a term applied to a tank or smaller receptacle filled with water and stocked with aquatic animals and plants for study, or, in the smaller examples, for mere beauty and interest. To maintain natural conditions, both plants and animals must be present — the plants to give off oxygen for the animals, as well as to furnish food for many of them and the animals to supply carbonic acid to the plants. With aëration and the removal of any dead animal or rotting plant, the water may be kept in good condition for a long time if supplied with a number of mollusks for the consumption of the too abundant growth of the algæ and of their spores, which otherwise soon fill and discolor the water. When aquaria are placed in insufficient light noxious fungi sometimes develop in them, doing injury to the other inmates. The secret of success in conducting an aquarium in a necessarily confined space is the scientific balancing of plant and animal life, and their proper relation to the volume of water. This once accomplished, the water need never be changed. There may be a small accumulation of sediment to be removed at long intervals, and sufficient water may be added to replace that lost by evaporation. The commonest mistake (to be avoided) is overcrowding. The space in which a few animals will thrive in delightful fashion may prove a "chamber of horrors" if too many animals are placed in it. There is not the same danger in an oversupply of plants, and it is better to err in this direction than to scant the provision. However, if there are too many plants, the weaker growers will begin to die off. Then either the vegetation may be reduced or another animal may be added to secure the perfect balance.

It should be remembered that in nature the only light reaching a pool comes from overhead. The artificial pool should counterfeit the natural conditions as nearly as may be. While it adds much to the pleasure to be derived from an aquarium to have it at a window so that the light may come through the sides, the ends should be dark, and in no case should the direct rays of the sun be allowed to penetrate into it. A curtain or shield which may shut out all light as high as the top of the tank is an advantage. It can be lowered when a clear view is desired.

Plants give off oxygen only under the influence of light and none at all at night. For this reason aquarium plants able to give just the needed oxygen by day are not sufficient to leave enough oxygen dissolved in the water to last the animals all night, and it is not uncommon to see the fish at the top of the water in the morning "sucking air," even in carefully handled aquariums. This condition suggests its own remedy in the addition of one or more plants. In winter, for the same reason, the aquarium requires at least one-third more plants, the daylight being so short and the period of inaction of the oxygen producers so long.

A cubic foot of water gives room enough for not more than three fish three or four inches long. Besides these there may be two newts, which obtain a large amount of the oxygen they need by rising to the surface and filling their air sacs. Two or three tadpoles and as many water snails will be needed to act as scavengers. They clean up decayed vegetation, surplus food and the excreta of the higher animals. A crawfish and a small turtle may be added. In choosing the fish it is well to know that gold fish and all kinds of carp are not carnivorous, and so more easily fed, and there is less danger from uneaten food. The catfish and sunfish, however, are easy to keep, and specially prepared food may be bought for them. A variety of plants is desirable, but every aquarium should have several specimens of *Vallisneria spiralis,* noted as an abundant producer of oxygen. The marine aquarium is even more interesting than the fresh water type and falls under the same rules. Salt water fish are in general carnivorous, and while they are easily fed with bits of fish or oysters, any uneaten food rapidly decomposes and fouls the water.

All aquarium fish, but particularly those in fresh water, are subject to fungous parasites which attack their eyes, gills or any chance wound. They may frequently be cured by removal to a separate vessel in which is a large oversupply of plants, and where the light is strong on one side. Any ailing fish should receive this "oxygen cure." The large public aquaria which exist in many cities are a great aid to students and a constant source of entertainment to the people. In America the aquarium of the United States Fish Commission at Washington and New York city

aquarium are most important. The latter is under the control of the New York Zoological Society and was established in 1897 in old Fort Clinton (known for many years as Castle Garden) on the Battery. It is entirely free and has a daily average of 4,000 visitors; both marine and fresh-water animals are exhibited. In the floor are seven large pools, and the wall tanks number nearly 100. All the arrangements are the best which experience has yet suggested, and opportunities for special study of ichthyology and the natural history of marine animals are afforded. In Europe the aquarium at Brighton, England, and particularly that connected with the Marine Laboratory at Naples, are of the greatest interest and importance. Consult Smith, G. E., 'The Aquarium' (New York 1900); Smith, E., 'The Aquarium and How to Care for It' (New York 1902); Eggeling, O., and Ehrenberg, F., 'The Fresh Water Aquarium and Its Inhabitants' (New York 1908); Verrill, 'Invertebrates of Vineyard Sound,' in the annual reports of the United States Fish Commission for 1871–72; Wolf, H. T., 'Goldfish Breeds and other Aquarium Fishes' (Philadelphia 1908).

ERNEST INGERSOLL.

AQUARIUS (the water-bearer), in astronomy (1) the 11th of the 12 ancient zodiacal constellations, now generally called signs of the Zodiac. (2) A division of the ecliptic — that between 300° and 330° of longitude which, on account of the precession of the equinoxes, has gradually advanced from the constellation Aquarius, once within those limits. The sun enters this part of his course about the 21st of January, at which time there are generally copious rains in Italy, whence the name Aquarius = the water-bearer or water-man (Herschel's 'Astronomy,' §§ 380, 381). It is marked thus ♒.

AQUATIC ANIMALS, a term denoting animals living constantly in water, and also those which swim on its surface or plunge beneath it for food. While the great majority of crustaceans are aquatic, a few, such as the wood-louse and the land crab, are modified for life ashore. Among mollusks there is occurrence of both aquatic and terrestrial habit, while numerous forms illustrate the transition from the former to the latter. The ascidians are exclusively marine. Some fishes have a limited power of life out of the water, the double-breathing *Dipnoi* being in this connection especially instructive. Among many amphibians the transition from water to terra firma is seen in the individual life-history, when the fish-like gilled tadpole becomes the lunged gill-less frog; while in a few exceptional cases such as the black salamander of the Alps, the life is terrestrial from first to last, and even the young dispense with their preliminary swim as tadpoles, although a brief recapitulation of their aquatic life is still represented by a gilled stage within the body of the parent. The instance of the gilled axolotl becoming, in the absence of sufficient water, the gill-less amblystoma, forcibly illustrates the importance of the medium as a factor in evolution. Among reptiles there are numerous aquatic forms — chelonians, lizards, snakes and crocodiles — though the absence of any gill respiration marks the progressive general adaptation to terrestrial life. While an emphatically terrestrial amphibian like the tree-frog seeks a watery hole for the rearing of the young gill-breathing tadpoles, the habit is reversed in such reptiles as the sea turtle, which, having returned to the more primitive aquatic home, yet revisits the land for egg-laying purposes. The cradle of the young in both cases indicates the ancestral habit of the parent. Among the emphatically aerial birds there are cases, like that of the penguin, where the structure has become adapted to an almost exclusively aquatic life. Among mammals the sea-cow, the seal and the whale are familiar illustrations of very different types which have returned to the primeval watery home and aquatic habit, with consequent change of structure.

It is important to note the general fact that, in the water, animals are subjected to influences somewhat different in detail from those which mold their congeners ashore. Even contact with a different medium, varying in composition, in currents, in pressure, in contained food and oxygen, and the like, obviously involves a great diversity in structure. Modes of motion, from the swimming-bell of a medusoid contracting and expanding in the tide, to that of the lowest vertebrates as illustrated in the pelagic tunicates, or from the paddling of worm and crustacean to that of fish and frog, duck and seal, are at once familiar adaptations to, and necessary results of, aquatic life. Similarly the smooth and frequently fish-like form, especially of actively locomotive water-animals, is a very noticeable adaptive result of the conditions of life. In the more thoroughly aquatic animals, which have remained in the primitive environment, and not merely returned to it, the blood is usually purified by being spread out on feathery gills which catch the oxygen dissolved in the water; while in terrestrial forms which have betaken themselves to an aquatic life, the ordinary direct "air-breathing" is still accomplished at the surface of the water, or in some isolated cases of insects and spiders, by means of the air entangled in their hairs, or even conveyed into their submerged homes. The aquatic respiration of some larval insects, the power that some crustaceans and fishes have of keeping up a respiration on land with a minimum of water about their gills and, above all, the cases of the double-breathing fishes or *Dipnoi*, and of amphibians already referred to, are especially instructive in regard to the problem of transition from one medium to the other. The genuinely aquatic animals are known to have a body temperature not much higher than that of the surrounding medium, and often survive even the freezing of the water; while in the higher warm-blooded vertebrates which have returned to an aquatic habit, various modifications, such as thick fur and plumage, waterproof varnish, formation of blubber, serve as protections against the cold.

AQUATIC PLANTS, a term applied to plants growing in or belonging to water. All vegetation was probably aquatic at first, certain plants becoming terrestrial by degrees. Numerous plants are, moreover, in the strict sense of the word aquatic, having never acquired or having lost all direct connection with

the soil. The algæ are mainly aquatic, though many occur in damp situations on land, or on other organisms, while others remain for long periods quiescent in comparative dryness. Many algæ are absolutely isolated in the water, while others are more or less intimately fixed to some solid substratum. Fungi are very seldom found in water, and lichens are also emphatically terrestrial. Some liverworts, again, occur floating in lakes, but the majority grow in very damp places and mark the transition to the generally terrestrial life of mosses and ferns. Some rhizocarps, such as *Salvinia*, are aquatic, with leaves rising to the surface, while others are land or marsh plants, like the higher horse-tails and club-mosses.

Among the flowering plants, or phanerogams, a return to aquatic life is exhibited by numerous though exceptional cases, while a very large number grow in moist situations and have a semi-aquatic habit. The simple monocotyledons, known as *Helobiæ*, or marsh lilies, are more or less strictly water-plants. The arrow-head (*Sagittaria*), and other *Alismaceæ;* the *Butomis* of the marshes; *Hydrocharis*, with floating kidney-shaped leaves; the water-soldier (*Stratiotes*), with narrow submerged leaves; and the Canadian pond-weed (*Anacharis*), which, though entirely flowerless in Europe, threatens to choke some canals and lakes, are familiar representatives. The little duckweed (*Lemna*), floating on the surface of stagnant pools, is one of the commonest aquatic monocotyledons; and the pond-weeds (*Potameæ*) found in both fresh and salt water; the lattice plant (*Ouvirandra*), with its skeleton leaves; various estuarine and fresh-water naiadaceous plants—for example, *Zostera* and *Naias*, are also common instances, while those growing in marshy ground are far too numerous to mention. Among dicotyledons the white water-buttercup (*Ranunculus aquatilis*), with its slightly divided floating and much dissected submerged leaves; the yellow and white water-lilies (*Nymphæa*); the sacred lotus flower of the Ganges and Nile (*Nelumbium*); the gigantic *Victoria regia* of tropical South America; and the insectivorous bladderwort or *Utricularia*, are among the more familiar aquatic forms.

AQUATINTA, the name given to a method of engraving or etching upon copper or steel, invented by Leprince in 1760. The outline of the subject having been etched and bit, the plate is thoroughly cleansed and a thin layer of etching ground is again spread over it. When dry the parts of the subject to be aquatinted are carefully painted over with a mixture of olive oil, turpentine and lamp-black; this fluid, laid on with a hair pencil, quickly dissolves the parts of the ground it covers, which are then wiped off. The plate is next dusted all over with a finely-powdered white resin or mastic, and when equally distributed the superfluous resin is shaken off and the plate gently heated over a charcoal fire till the resin dissolves and adheres to the bare metal. In dissolving, the grains of the resin run into small granules, leaving minute and peculiarly shaped portions of the metal open to the action of the aquafortis, a weak solution of which is then poured over the plate. When corroded to the proper strength the subject has acquired what may be termed the first wash of color. The plate is then cleaned, re-covered with ground, and treated as before, for the second tint. The process is repeated until all the deeper tones of shading are completed. These operations are sometimes reversed, the darkest shades being first bit in and the lighter ones added by degrees.

AQUEDUCTS. Aqueducts are artificial channels and structures connected therewith, for conveying water from one point to another. In a broad sense the word is generic, applying to all such channels or structures, but it is now generally restricted to elevated structures or tunnels designed to convey water by gravity for municipal water supply, though it is not infrequently used in connection with irrigation, water power and other hydraulic developments.

Water being a prime necessity for the support of both animal and vegetable life, it is not surprising that devices and means for supplying it in large quantities for domestic use in cities and for irrigation purposes attracted the early attention of mankind. Their construction and use dates far back of the historical period, and they were doubtless among the earliest and most important engineering undertakings of ancient times. The ruins of these early canals and water-supply works are found in Phœnicia, Babylonia, Assyria, Egypt, Persia and Palestine. Some of them were of such magnitude and designed and constructed with such boldness and skill as to excite the wonder and admiration of the modern world.

Ancient Aqueducts.— The Phœnicians were especially notable for the character, extent and boldness of their hydraulic works and, considering the means at their command, it is surprising what they accomplished.

At a later period Greece and Rome became famous for their water-supply projects and the building of great aqueducts. In Greece, early examples of tunnel constructions for water supply were quite common, some of them being of comparatively great length and, at places, more than 100 feet below the surface. One such tunnel at Samos was four-fifths of a mile long, the interior dimensions being 8x8 feet — the water conduit proper being an independent stone trough. Athens was supplied by several aqueducts, built from time to time as the city grew and a larger water supply became needed. One of these, begun some 600 years B.C., under the Emperor Hadrian, is still in use.

Rome was supplied with water by about a dozen aqueducts built at different periods, nine of which are commonly referred to by writers as the more important. The first, the Aqua Appia, was built about 300 years B.C. It was about 11 Roman miles long and almost wholly underground. Among the latest of the nine to be built were the Aqua Claudia and the Anio Novus, completed in the first half century of the Christian era.

Some of these aqueducts would be considered as stupendous undertakings in modern times. Thus the second one built, the Anio Vetus, was more than 40 miles long, mostly in tunnel. The Aqua Marcia, built about 140 B.C., was 60 miles long, about six miles of which were above ground, carried on masonry arches.

The Aqua Tepula, some 11 miles long, was carried for more than half the distance on a second series of arches, superimposed upon

those of the Aqua Marcia. The Aqua Augusta was 22 miles long, of which something over 1,000 feet were carried on masonry arches. The Anio Novus, 62 miles long, was carried across the Campagna for more than nine miles by a series of masonry arches, part of which still remains a conspicuous feature of Roman scenery. The water channel carried above the arches was from three to four feet wide and nine feet high, the inside being lined with Roman cement.

Not only at Rome, but in many places throughout the empire did the Romans build great aqueducts. Among the most noted of these may be mentioned those at Servigonia, Italy; Segovia and Tarragona, Spain; Metz in Alsace-Lorraine; Carthage, Constantinople, and Nimes in France. The latter, now known as the Pont du Gard, is a magnificent structure across the river Gardon, built in the 4th century A.D. It has three tiers (or stories) of masonry arches, one above the other. The lower tier has one arch (over the river), of 75 feet span and five others of 60 feet span. The third or uppermost tier is made up of a series of smaller arches, in all 873 feet long, the greatest height over the river being 188 feet. The masonry water conduit, covered by flat stones and lined with cement, is about four feet wide and four and one-half feet high. This grand structure, still standing in a good state of preservation, compares favorably in its engineering and architectural features with any similar work of modern times.

The aqueduct at Segovia has an arched masonry structure nearly half a mile long, having 109 arches which reach a height of slightly over 100 feet. The aqueduct at Tarragona, Spain, is 876 feet long and 83 feet high; that at Metz, built in the 4th century A.D., now partly in ruins, was carried across the river Moselle by a masonry structure 60 feet high; that at Antioch, Syria, of rather unusual design, is 700 feet long and 200 feet high; that at Moris is about 500 feet long and 80 feet high, built in three tiers of arches, the uppermost of which is of brick. The Roman aqueduct at Carthage was about 60 miles long, a part of it carried by an arched masonry structure about 50 feet high. Many other notable aqueducts were built in early Roman times in Europe, Asia Minor and Africa.

With the decline of the Roman empire the building of great aqueducts almost ceased during the Middle Ages, though there are a few notable examples. That at Spoleto, Italy (800–900 A.D.), seems to have been the first instance where the Gothic arch was introduced into aqueduct work. With a height of 300 feet and its 10 arches of 66 feet span, it was of especially light and graceful design. Among several mediæval aqueducts at Constantinople, that of Justinian ("Muallak Kemer") is remarkable for the beauty and excellence of its design and construction. It is 720 feet long and 108 feet high, having two tiers of pointed arches, the lower having spans of 55 feet and the upper ones of 40 feet.

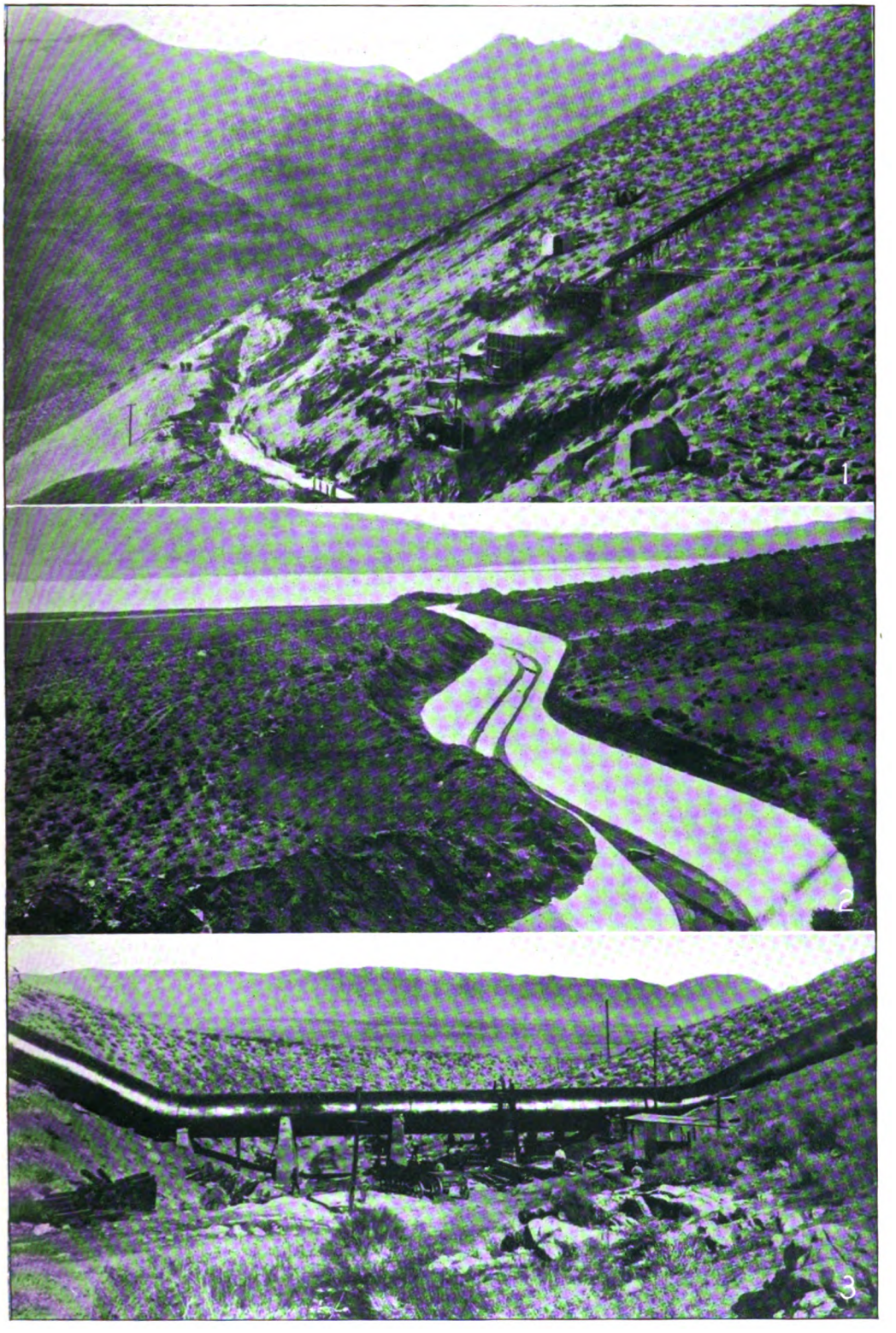
The Greeks and Romans had little choice in the materials or methods of aqueduct building. Large pipes, of any material, were not available, though where pressure was to be resisted the earlier builders sometimes used as a substitute large blocks of stone pierced with a hole of the required size for the conduit, the faces of the blocks being dressed to fit together and to make joints as nearly watertight as possible. The Romans built their water conduits, both in tunnels and over viaducts, of masonry lined internally with Roman cement. The driving of long tunnels, often at considerable depths below the surface, must have been a slow and costly process with the tools and methods then known. The difficulties of following correct alignments and gradients underground, with the knowledge and instruments then available, were very great, as evidenced by the tortuous course of many of these tunnels. For the elevated structures stone masonry was the only adequate construction then available. The extensive use of hydraulic concrete had not been developed, though occasionally employed, but Roman cement was generally used for water-proofing. Their masonry was generally built up of large blocks of granite or other hard and durable rock, with fairly well-dressed joints, laid dry; that is, without mortar. Their foundation work seems to have been of a high order, for foundation failures in these great structures were very rare. Brick was used to some extent, especially in their later constructions, and there are examples of brick-faced masonry backed by concrete.

Modern Aqueducts.—The resumption of aqueduct building on a large scale dates back less than 200 years, and most of the aqueducts of any considerable magnitude are of quite recent construction. A few of the more notable on the eastern continents may be mentioned.

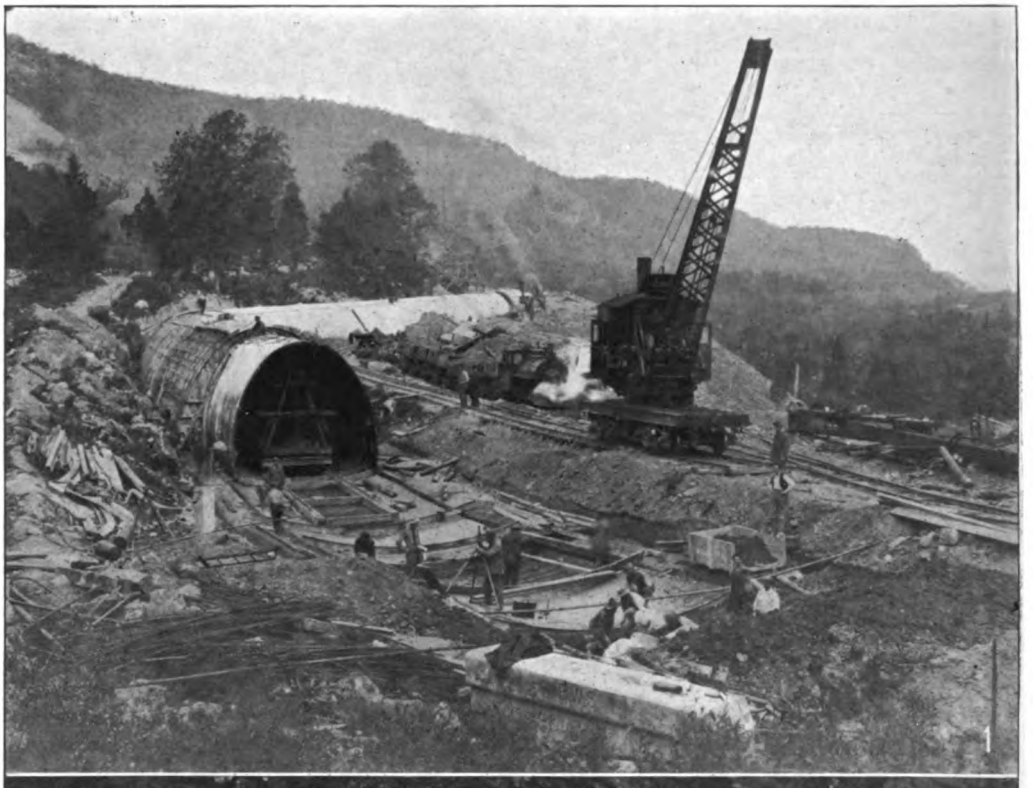
Marseilles has a (now navigable) canal, constructed 1837–48, 97 miles long, connecting the river Durance with the Mediterranean, and the city's water supply is carried from this canal over the river Arc by the magnificent masonry aqueduct of Roquefavour.

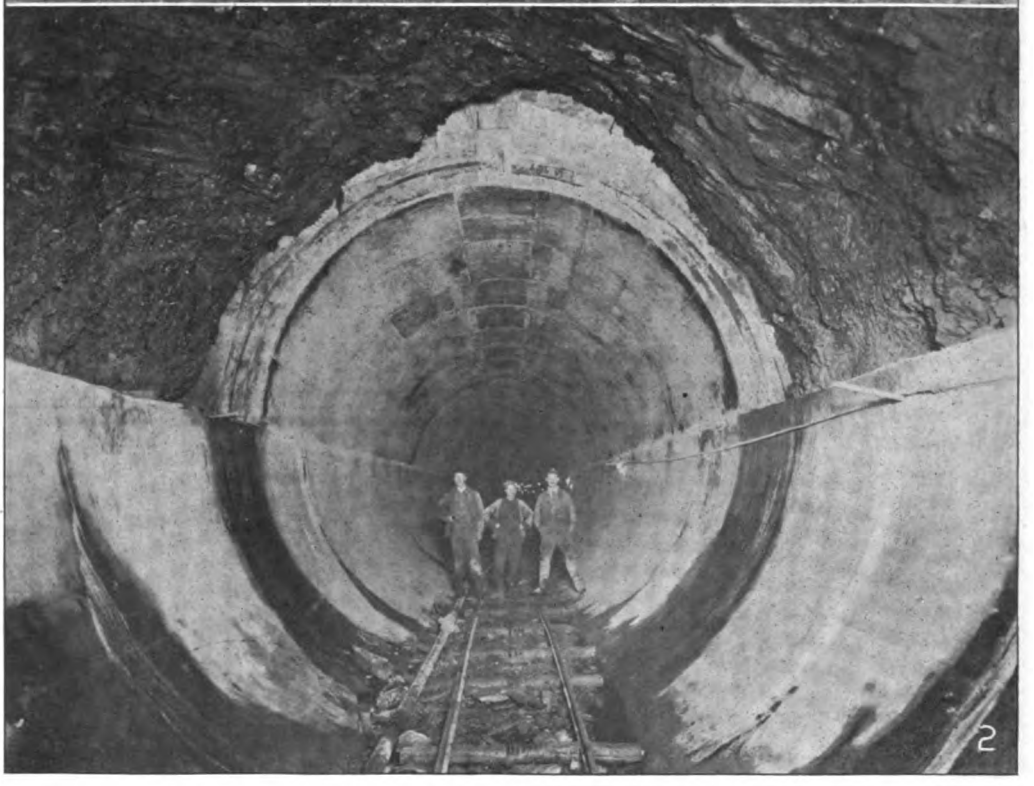
The Thirlmere Aqueduct supplies Manchester with about 50,000,000 gallons of water per day, bringing it from lakes 96 miles from the city. Of this length, 14 miles are in tunnel, 37 miles are "cut and cover" work, with a water channel 7x7 feet, and 45 miles are of cast-iron pipes, the design being for five pipes of 40 inches internal diameter adjacent to each other, only three of which have yet been laid. (The term "cut and cover" work may be briefly defined as a conduit of masonry or other material, constructed in an excavated trench wide enough to receive it and of such depth that when completed and the excavated material filled back, the conduit will be entirely covered and thus become, in effect, a tunnel). The cost of this aqueduct in its present condition has been in the neighborhood of $20,000,000.

Liverpool is supplied with water from the river Vyrnwy in northern Wales, delivered through an aqueduct 68 miles long, consisting, for the most part, of two lines of cast-iron pipe from 39 to 42 inches in diameter, provision being made for a third pipe when it becomes necessary. The fall from the Vyrnwy to Liverpool is so great (550 feet) that it was necessary to relieve the pressure in the pipes by interposing equalizing reservoirs at a number



1 Cut-and-Cover Work on steep slope in Mountain Division, Los Angeles Aqueduct
2 Open Lined Conduit in Owens Valley, showing Owens Lake in background, Los Angeles Aqueduct
3 Siphon Crossing, No Name Canyon on Concrete Piers, Los Angeles Aqueduct





1 Catskill Aqueduct — Typical cut-and-cover aqueduct construction, showing excavated trench, steel forms, partial and complete concrete aqueduct and ungraded earth cover. The waterway is 17 feet high and 17½ feet wide, and has an area of 241 square feet

2 Typical pressure tunnel construction, showing completed excavation and partial and completed concrete lining. The predominating diameter is 14 feet, 6 inches and the pressure tunnels always have a cover of at least 150 feet of sound rock

of different points. Birmingham is supplied with 75,000,000 gallons daily by an aqueduct 74 miles long.

One of the greatest and most important modern masonry aqueducts is that known as the Nadria Bridge which carries the great irrigation canals conveying the water of the lower Ganges canal over the Kala Naddi. Its length is very nearly one-quarter of a mile and the width between vertical ends of the arches is 150 feet. It is constructed with 15 arches of 60 feet span. The foundations were the most troublesome feature of its construction, as they consisted of 268 circular, concrete-filled, brick cylinders carried to a depth of about 50 feet below the bed of the river. The aqueduct was opened in 1889 and is said to have a capacity of 4,100 cubic feet per second.

The evidence of early aqueducts on the western continent is meager, and the remains of them so far discovered are few. It seems to be well established that the Indians of the western part of the United States constructed canals of considerable magnitude to supply water for irrigation. Recent exploration in Peru, in the heart of the Andes, has disclosed canals and aqueducts of great extent, built by the Incas or their predecessors, some of which are wonderful constructions considering their antiquity and the difficulties to be overcome. Consult Cook, O. F., in *National Geographic Magazine* (May 1916).

The Spanish during their occupation of Mexico built aqueducts of considerable magnitude to supply the City of Mexico with water. The remains of at least one of these still exist in and near the city, consisting of an arched masonry structure quite like its Roman predecessors. It terminated in the city with a masonry fountain structure of no little artistic merit.

There are three aqueducts now supplying water to New York city. The first, or old Croton Aqueduct, was begun in 1837 and completed in 1843. It is mainly a masonry conduit, following the surface topography wherever practicable, but there are two stretches of cast-iron pipe. It takes water from the Croton Reservoir, 41 miles north of the city. The Harlem River is crossed at a point about 11 miles north of the Battery by a masonry viaduct, known as High Bridge, 1,450 feet long, the greatest height above the foundations being about 150 feet. There are eight semi-circular arches of 80 feet span and seven of 50 feet span. Both in design and construction it is a beautiful and substantial structure, a fitting monument to its builders. The aqueduct has a capacity of 80,000,000 gallons per day and cost between 11 and 12 millions of dollars.

The new Croton Aqueduct was begun in 1887 and water was turned into it 15 July 1890. The water is taken from the same source — the Croton Reservoir (or lake) — as the Old Croton Aqueduct, the two inlets being near each other. The new aqueduct follows the same general course, but is much more direct than the old and crosses the Harlem River near the masonry structure of the earlier Croton aqueduct. While the aqueduct proper ends at 135th street, the water is carried from there to the Central Park Reservoir through eight lines of 48-inch cast-iron pipe. The length is 30.87 miles, of which all but slightly over one mile is in tunnel. The capacity of the aqueduct is about 300,000,000 gallons per 24 hours.

The tunnels are lined with masonry and concrete, the section for 23.7 miles being of horseshoe form, 13 feet 7 inches wide, and about the same in height. The remainder is of circular section, varying in diameter from 14 feet 3 inches to 10 feet 6 inches under the Harlem River. The difference in elevation between the crest of the new Croton dam and the surface of the water in the Central Park Reservoir is 33.65 feet, and as the total distance is 33¼ miles, the average hydraulic gradient is about 3.3 inches per thousand feet.

The most interesting construction feature of this aqueduct is the crossing of the Harlem River. At the eastern approach to this crossing, where the tunnel is about 150 feet below the surface, it drops on a 15 per cent descending grade for about 850 feet, followed by a 2 per cent descending grade for 200 feet, where it enters a vertical shaft 12¼ feet in diameter and 168 feet deep. From the bottom of this shaft the tunnel crosses under the river upon a 1 per cent descending grade with a diameter of 10½ feet for 1,270 feet, and rises in a vertical shaft 321 feet deep, from the top of which it descends on a slight falling grade to 135th street. The bottom of the tunnel at the river crossing is 300 feet below mean tide. This aqueduct was, at the time, by far the greatest engineering feat of its kind in America, if not in the world. Its cost was very close to $30,000,000.

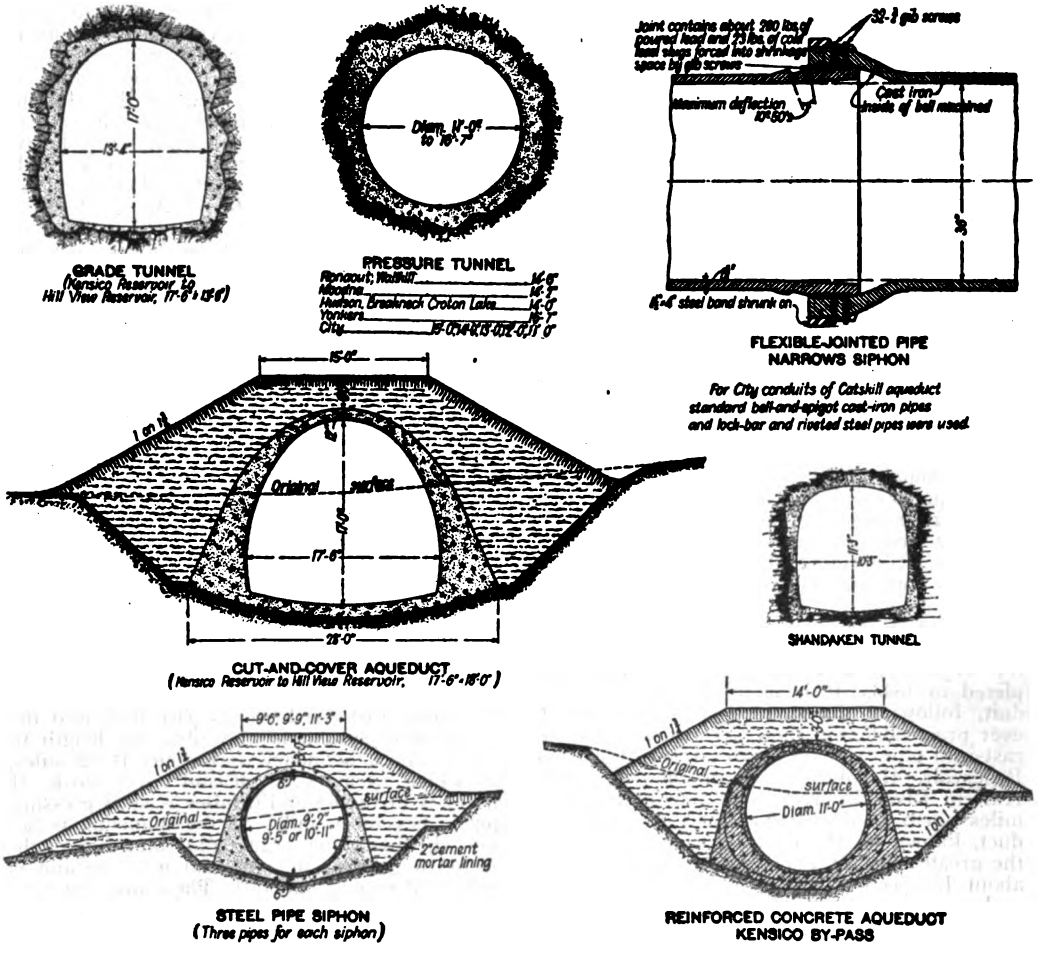
The great Catskill Aqueduct, the completion of which was celebrated with appropriate ceremonies on 12–15 Oct. 1917, augments the water supply of Greater New York by from 500 to 600 million gallons per day. Its purpose is to carry to the city the water from a new source of supply in the Catskill Mountains. The water entering it from the colossal Ashokan Reservoir, about 12 miles west of Kingston, N. Y., flows by gravity through the new Hill View Reservoir just north of the city line, into the distribution system of the city. Its length to the northern boundary of the city is 92 miles, of which 55 miles is cut and cover work, 31 miles is in tunnel and 6 miles is steel pressure pipe. Seventeen miles of the tunneling is below the hydraulic grade and, therefore, subjected to greater than normal pressure and is called "Pressure Tunnel." These pressure tunnels, of circular section, generally 14½ feet inside diameter, are used to carry the aqueduct under streams or depressed areas along the route. As the route crosses the drainage system of the region, several of these pressure tunnels are required, though steel pipes are used for the purpose where the conditions made them necessary or more economical. The pressure tunnels are placed at a sufficient depth below the surface of the rock formation, usually about 150 feet, to insure sound rock and to resist the internal water pressure. The great pressure tunnel under the Hudson River at Storm King, about four miles above West Point, is by far the boldest and most remarkable undertaking of the kind in the world. In order to secure sound rock and to withstand pressure and leakage, it was found necessary to drop the aqueduct tunnel to a position 1,100

feet below the surface of the river and about 1,500 feet below the hydraulic grade. Vertical shafts from the approach tunnels were sunk on each side of the river, 3,022 feet apart, to the necessary depth, and the horizontal river tunnel driven between them.

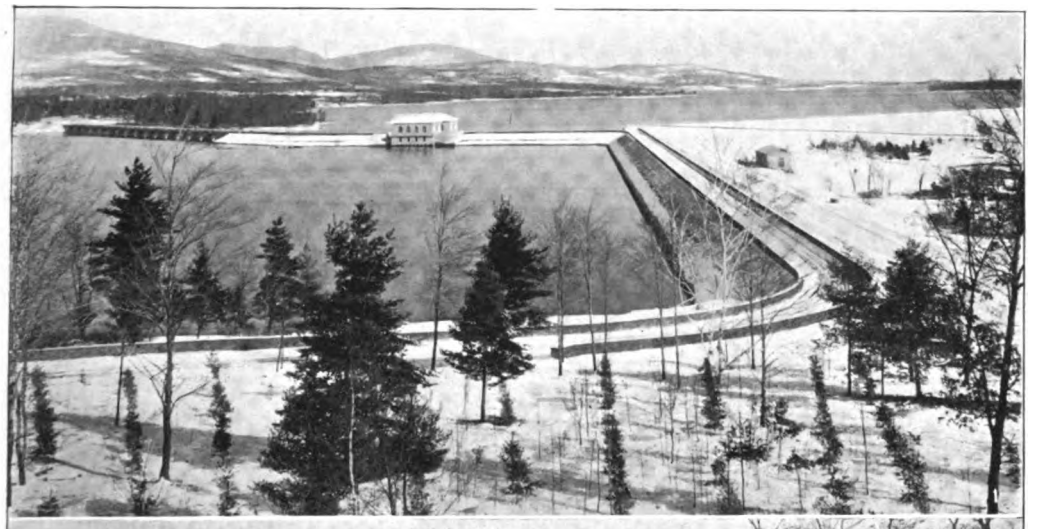
All the tunnels are lined with concrete; those upon the hydraulic grade, of horseshoe section, have a completed width of 14 feet 3 inches and a total height, from invert to the soffit of the arch, of 17 feet. The pressure tunnels are of circular section, varying in diameter from 16 feet 7 inches to 14 feet — the latter being at the Hudson River crossing. Where steel pressure pipes are used they are lined inside and sheathed outside with concrete. The cut and cover work consists of a strongly designed concrete conduit with arched invert, sides and crown, constructed in place and surrounded and covered to a depth of not less than 14 feet with earth.

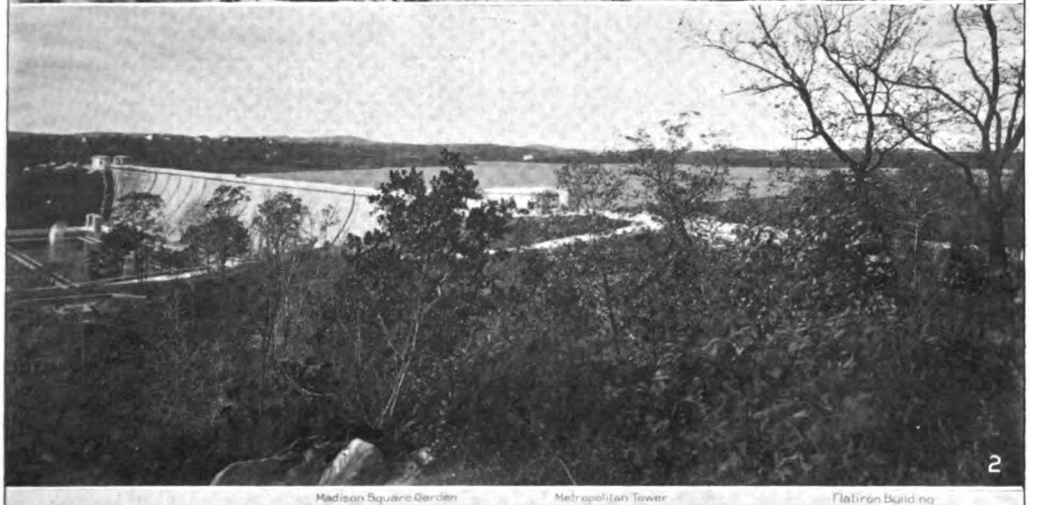
The difference in elevation between the flowline of the water as it emerges from the Ashokan Reservoir and the water surface of the Hill View Reservoir is 216 feet, giving an average hydraulic gradient of about 2⅓ feet per mile.

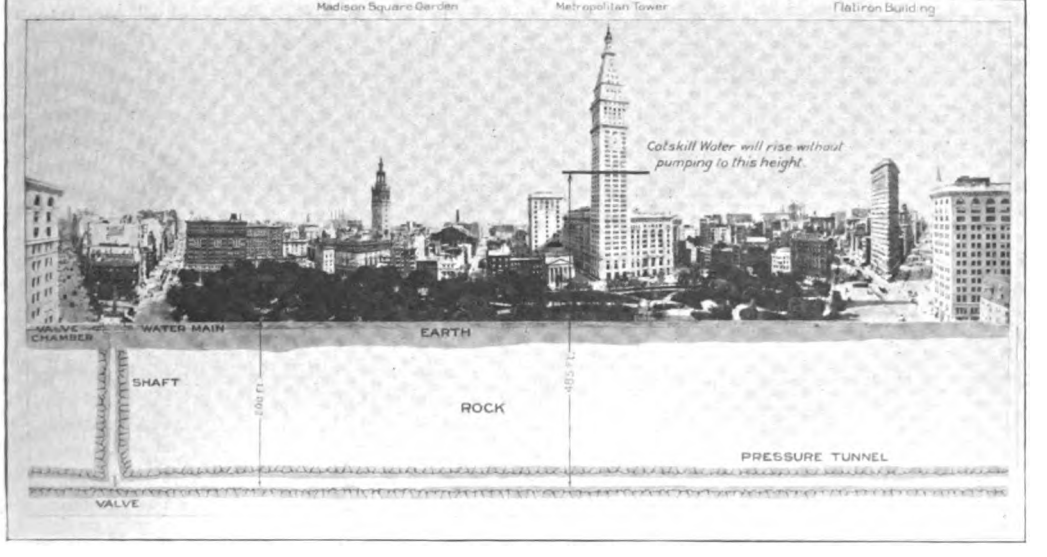
The aqueduct proper strictly may be considered as extending from the Ashokan Reservoir to the Hill View Reservoir, though in fact it extends into and under the city. The distribution of such an enormous volume of water to the different boroughs of the greater city presented a troublesome problem. It was solved by continuing the great tunnel southward through the borough of Manhattan and under the East River into Brooklyn. From the termini of this tunnel the water is carried eastward into the borough of Queens and southward to the borough of Richmond (Staten Island) through pipes, the last named branch involving the crossing of New York Bay at "The Narrows" by a pipe laid in a trench dredged into the bottom of the bay. The length of the city tunnel is 18 miles. Its diameter, 15 feet at the northern end, decreases to 11 feet at its ends in Brooklyn as the quantity of water to be delivered diminishes. Its depth below the surface varies from 200 to 750 feet. Frequent shafts facilitated construction and provide for connection with the distributing pipe system under the streets. The cost of the aqueduct proper from the Ashokan Reservoir to the city


GRADE TUNNEL
(Kensico Reservoir to Hill View Reservoir, 17-6" x 13'6")
PRESSURE TUNNEL
Diam. 14'-0" to 16'-7"
FLEXIBLE-JOINTED PIPE NARROWS SIPHON
For City conduits of Catskill aqueduct standard bell-and-spigot cast-iron pipes and lock-bar and riveted steel pipes were used.
SHANDAKEN TUNNEL
CUT-AND-COVER AQUEDUCT
(Kensico Reservoir to Hill View Reservoir, 17-6" x 15'0")
STEEL PIPE SIPHON
(Three pipes for each siphon)
REINFORCED CONCRETE AQUEDUCT
KENSICO BY-PASS

Standard types of conduit used in the Catskill Aqueduct. (In addition to the above, riveted and lock-bar joint steel pipes and bell-and-spigot cast-iron pipes of ordinary types were used).







1 Ashokan reservoir, showing portions of the Beaverkill and Dividing dikes, the Lower and Upper gate-chambers, Ashokan bridge, and the Dividing weir under the bridge
2 Kensico dam and reservoir viewed from the State highway which passes along the easterly side of the reservoir
3 A full circle panorama of New York City's streets around Madison square, showing Shaft 18 and a portion of the City tunnel in the rock more than 200 feet beneath the surface

line has been $61,000,000, and the tunnel from the city line to Brooklyn has cost $22,500,000. The total cost of the project was $140,000,000.

Another of the greatest aqueduct projects in the world is that recently completed to supply the city of Los Angeles, Cal., with water. The source of the supply is the Owens River in the heart of the Sierra Madre Mountains. The total length of this aqueduct, including the diverting canal and reservoirs, is about 233 miles. It is designed to deliver 260,000,000 gallons per day. As this quantity is greater than will probably be needed for the domestic use of the city for many years, it is intended to utilize the surplus for irrigation purposes, and the great fall in the course of the aqueduct is intended to be utilized for water power purposes. The water is taken from the Owens River at an elevation of 3,815 feet above the sea, and carried thence by an open canal a distance of about 60 miles to the Haiwee Reservoir, where the aqueduct proper begins, the water surface in this reservoir being 3,760 feet above sea-level. The length of the aqueduct from this reservoir to its end in the San Fernando Valley is about 171 miles. The leading types of construction and the aggregate length of each type in miles is: Unlined canal, 24; lined canal, 37; covered conduit, 98; tunnel, 43, and steel syphon, 12.

The covered concrete canals are approximately of rectangular section, covered by flat slabs of reinforced concrete, with an interior cross-sectional area of 94 square feet. The tunnels, lined with concrete, have curved inverts, straight (inclined) sides and arched roof. Steel pipes are chiefly used to carry the aqueduct under streams and gorges and down the steep declivities below the hydraulic gradient. Such declivities or steep descents occur at three principal localities, creating great pressure, which is to be utilized for generating water powers. This will result in no loss of water, since it will be returned to the aqueduct at a lower level. The cost of the aqueduct and its accessories has been $24,600,000.

The city of Winnipeg, Canada, has built a gravity aqueduct for a new water supply. It receives water from Indian Bay on Shoal Lake and is approximately 100 miles long. It involved comparatively simple construction, 85 miles being of covered concrete conduit, 10 miles of five feet steel pipe, less than one-fifth of a mile of tunnel, and slightly over two miles of 48-inch cast-iron pipe. It is designed to deliver over 100,000,000 gallons per day.

The city of Denver, Colo., has been supplied with water by an aqueduct about 20 miles long, consisting of two lines of wood-stave pipe, one of 30 inches and one of 24 inches diameter — the two delivering about 30,000,000 gallons per day.

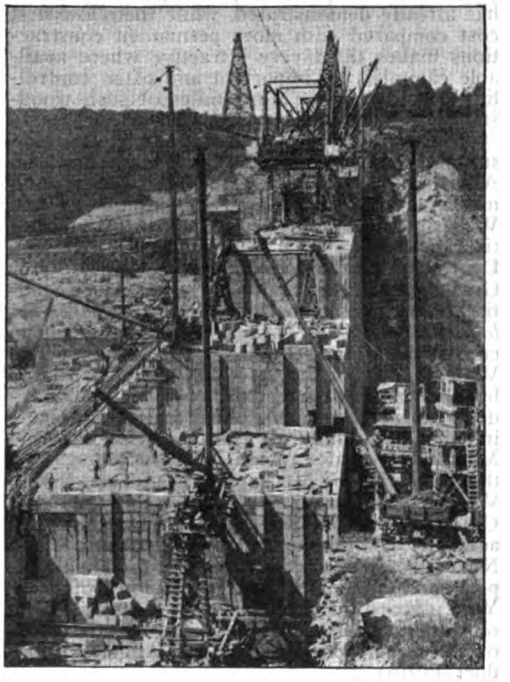
Many other American cities have aqueducts of greater or less extent and importance connected with their water supply, and a large number of water power developments and irrigation projects utilize like structures.

Modern Construction.— High, massive stone masonry aqueducts are now seldom constructed, and where such elevated structures are unavoidable, they are usually built of hydraulic concrete. The modern engineer finds it generally better and more economical to carry his conduits under, rather than over, streams and depressions.

The introduction of cast-iron and steel pipes of large size, and their comparative cheapness, as well as the wonderful development in the science and art of tunneling, have practically revolutionized aqueduct building since the days of the Romans.

Cast-iron pipes of sufficient strength to withstand the pressures ordinarily required are now available up to a diameter of at least 48 inches and riveted steel pipes of double that diameter and capable of carrying even greater pressures are not uncommon, particularly when encased in concrete.

The general substitution of tunnels for aerial structures is largely due to the very great advancement in the speed and economy of driving tunnels. The perfecting of power rock drills, the introduction of modern high explosives, and improved appliances and methods for handling the excavated material, have greatly simplified and expedited rock tunneling. The invention of the "shield" method, the application of compressed air to resist the ingress of water and mud, supplemented by powerful pumps, together with the use of cast-iron or concrete tunnel linings, has made tunneling in soft or sub-aqueous material comparatively safe and rapid.



Kensico Dam during construction, showing the division of the dam by the expansion-joints. The two cableways spanning the valley aided in handling materials and equipment. The system of derricks on travelers and the single derricks, for placing stones and concrete, are also shown, as well as the railroad tracks for delivering materials to the derricks.

The ability, skill and practical ingenuity of the modern civil engineer and the perfection of instruments of precision for determining and maintaining underground alignments and gra-

dients have also been an important factor in overcoming the difficulties and reducing the cost of modern tunneling.

The construction of pipes and flumes of wood has marked another important advance in aqueduct building in this country. Comparatively large pipes built of wooden staves, accurately jointed with each other and bound by steel hoops at suitable distances apart, are in common use in the western States; and wooden flumes or canals supported upon wooden trestles, often of considerable height, may take the place of stone, concrete or steel viaducts. The durability of such wooden aqueducts has not yet been satisfactorily determined, but as they are constantly filled with water and often buried in the earth, their useful life extends over considerable periods, as experience has already demonstrated, while their low first cost compared with more permanent constructions makes them very attractive where available capital is an important and often controlling consideration. Many miles of such wood-stave pipes are now in successful use.

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AQUEOUS HUMOR, the designation of the transparent lymphatic fluid in the anterior chamber of the eye, or that portion of the interior of the eye in front of the crystalline lens. In its chemical composition aqueous humor closely resembles the cerebro-spinal fluid. It is a clear alkaline liquid, specific gravity, 1003–1009, and contains about 1 per cent of solids, one-tenth of which are proteids. These are fibrinogen, serum albumin and serum globulin. Traces of urea and sarcolactic acid are present. The secretion of aqueous humor is rapid. It is supposed that this fluid is derived from the posterior surface of the iris and the ciliary body. See EYE.

AQUEOUS ROCKS, the title of a rock class including all rocks that have been deposited under water. It is the most important class of the sedimentary series, and comprises such common and widely distributed strata as sandstones, conglomerates, shales and limestones, and many valuable products, as gypsum, salt and coal. According to their manner of origin the aqueous rocks may be subdivided into (1) mechanical deposits, (2) chemical precipitates, (3) organic accumulations. The mechanical deposits have been derived from the disintegration of pre-existing strata and the transportation of the materials by rivers, tides and currents. They are being formed at the present time beneath the ocean and in rivers and lakes. Sandstone, conglomerate, clay and shale are the most important members of this subdivision. The chemical precipitates owe their origin to the deposition of materials from solution either as a result of evaporation or by the action of precipitating agencies. Oölitic limestone, gypsum, rock salt, siliceous sinter and many iron ores are included in this subdivision. The organic accumulations have been formed from materials once belonging to living organisms. Limestones and chalk represent the comminuted and compacted remains of shells, corals, crinoids, foraminifera, etc., while certain organisms secrete silica and their casts have accumulated in the form of diatomaceous earth and chert. Peat and the different varieties of coal are deposits of vegetable matter, more or less completely transformed into carbon under the influence of pressure and sometimes also of heat.

AQUIFER, any rock mass that is sufficiently porous to be a good water carrier. It is a term much used in discussions of water supply. Due to the large size of the individual pores and the high percentage of porosity, sandstones constitute the best aquifers. Quartzites, shales and most igneous rocks have either very small pores or a very low percentage of pore space or both, and rarely constitute good aquifers. See WELLS; WATER SUPPLY; ARTESIAN WELLS.

AQUIFOLIACEÆ, ă'quĭ-fō-lĭ-ā'cē-ē, the designation of a family of plants, composed of shrubs or trees with alternate or opposite persistent leaves, of thick texture and smooth surface, with a toothed margin, the teeth being sometimes spinous. The flowers are solitary, or variously grouped in the axils of the leaves. The fruit is always fleshy, containing from two to six indehiscent woody or fibrous nucules or minute nuts enclosing single seeds. The American holly, *Ilex opaca,* has foliage less glossy, and berries less red than its European relative, *Ilex aquifolium.* Both are important commercially, being mostly used for decorative purposes. The leaves of a species of *Ilex* afford the famous Paraguay tea. But one member of this family is found in Europe, the common holly (*I. aquifolium*). The other members are found sparingly scattered over different parts of the world, especially the West Indies, South America and the Cape of Good Hope. The Latin *Ilex* is the holm-oak (*Quercus ilex*).

AQUILA, ă'kwę-la, one of the early Christians associated with Saint Paul, was of Jewish origin and a native of Pontus. In the year 52 he, with other Jews, was expelled from Rome by an edict of Claudius. He and his wife, Priscilla, went to Corinth, where they first became acquainted with Saint Paul. The apos-

tle shared their lodgings, at the same time assisting them at their trade of weaving tent cloth. He was indebted to them for many acts of kindness and none of the Christians who aided him ever received such warm praise from his pen. Consult Epistle to the Romans xvi, 3. There are many references to Aquila in the New Testament: Acts xviii, 1–3, and 26–28; 1 Corinthians xvi, 19; 2 Timothy iv, 19. Nothing definite is known about the death of Aquila. Though he led a poverty-stricken life in Corinth and Ephesus, better days came to him; for in the year 58 we again find him in Rome, where he and Priscilla kept a house on the Aventine, large enough to be used as a sanctuary by the Christians of Rome, to whom it was always open. Consult Fouard's 'Saint Paul and His Missions' (Chap. xii) and 'Saint Peter and the First Years of Christianity' (Chap. xviii).

AQUILA, Johann Kaspar, a celebrated German Protestant theologian: b. in Augsburg in 1488: d. 12 Nov. 1560. After studying several years in Italy he was appointed pastor of Jenga, a village near Augsburg. Here he embraced the doctrines of Luther; but his boldness and zeal in the cause of reformed faith led the bishop of Augsburg to order his arrest. Aquila passed the winter of 1519–20 in the prison of Dillingen, and from Dillingen he went to Wittenberg, where he became personally acquainted with Luther. He was subsequently appointed professor of Hebrew at Wittenberg, where he rendered valuable assistance to his colleague, Luther, in his translation of the Old Testament. In 1527 he became pastor and the following year Protestant bishop at Saalfeld; but his vehement opposition to the *Interim* of Charles V in 1548 obliged him to flee. He was appointed to the deanery of Schmalkalden in 1550, and restored two years after to his office at Saalfeld, where, without further molestation, he continued to discharge his duties till his death.

AQUILA, Ponticus, a native of Pontus, who flourished about 130 A.D., and is remembered for his exceedingly close and accurate translation of the Hebrew Scriptures into Greek. Consult Burkitt, 'Fragments of the Book of Kings, According to the Translation of Aquila' (1897).

AQUILEJA, ä'kwę-lā'ja, **AQUILEIA,** or **AGLAR,** Austria, town 22 miles northwest of Trieste. Before the fall of the Roman empire it was the great emporium of trade between the north and south of Europe, and was often called the "Second Rome." Cæsar Augustus frequently resided here, and several councils of the Church, the first in 381, were held at Aquileja. In the 6th century, the title of patriarch was taken by the bishops of Aquileja, who assumed second rank to the Pope. The town was destroyed by Attila in 452, when the inhabitants numbered 100,000. It is now a small fishing village containing a number of interesting remains of its ancient splendor, and often rewarding the researchers of the antiquary with relics of value. Pop. about 2,000.

AQUILIDÆ, the family of raptorial birds that includes the typical eagles (q.v.). By some it is now classed as a subfamily (*Aquilinæ*) of the *Falconidæ*.

AQUINAS, Thomas, a celebrated scholastic theologian, related by birth to several of the royal families of Europe: b. near Aquino in 1227; d. Fossanora, 7 March 1274. He studied at the Benedictine monastery of Monte Casino and the University of Naples. About the age of 17 he entered a convent of Dominicans, much against the wishes of his family. Partly to evade the endeavors of his family to recover him, and partly on account of the extraordinary aptitude he displayed for theological studies, his superiors sent him to Cologne to hear the lectures of the famous Albertus Magnus. He was so remarkable for taciturnity, and the assiduity and apparent stolidity with which he pursued his studies, that he was known among his fellow-students as "the great dumb ox of Sicily." His teacher, however, discerned his abilities and is said to have foretold that "this ox would one day fill the world with his bellowings." In 1245 he visited Paris in company with Albertus. Becoming involved in the dispute between the University and the Begging Friars as to the liberty of teaching, he advocated the rights claimed by the latter with great energy, and, being called upon to defend his side in this controversy before the Pope, did so with complete success. In 1248 he returned with Albertus to Cologne, but revisited Paris in 1257, when he received the degree of doctor from the Sorbonne and began to lecture on theology, rapidly acquiring the highest reputation. The remainder of the life of Aquinas was one of the most varied activity. He was almost constantly engaged in lecturing and preaching, and was often sent on distant journeys in the service of his order. In 1263 he is found at the Chapter of the Dominicans in London. In 1268 he was in Italy, lecturing in Rome, Bologna and elsewhere. In 1271 he was again in Paris lecturing to the students; in 1272 professor at Naples. In 1263 he had been offered the archbishopric of Naples by Clement IV, but refused the offer. A general council being summoned at Lyons in 1274 for the purpose of uniting the Greek and Latin Churches, Aquinas was called thither to present the council with a book which he had written on the subject, but died on the way. The honors paid to his memory were prodigious; beside the title of Angelic Doctor, bestowed on him after the fashion of the times, he was called the Angel of the Schools, the Eagle of Divines and the Fifth Doctor of the Church; in 1286 he was made by the Dominicans the doctor of their order (*doctor ordinis*); at the request of the Dominicans he was, in 1323, canonized by John XXII, his tomb supplying the necessary testimony of miracles; and 1567 was declared by Pius V the "Fifth Doctor of the Church." The numerous works of Aquinas are all written in Latin. The most important of them is the 'Summa Theologiæ,' which, although only professing to treat of theology, is in reality designed to form a complete and systematic summary of the knowledge of the time. All the minor works of Aquinas may be looked upon as preparatory to this great one. These are 'A Commentary on the Four Books of Sentences of Peter Lombard'; 'Quodlibeta Disputata et Quæstiones Disputatæ'; the 'Catena Aurea,' or Golden Chain, in form of a commentary on the four Gospels, but in substance an exhaustive exposition of the cardinal doctrines in theology of

the greatest fathers of the Church; and commentaries upon Isaiah and Jeremiah, the Epistles of Saint John the Divine and the Psalms, as well as upon Aristotle. His works were published in Rome in 1570–71 in 17 volumes, but his 'Summa Theologiæ' has passed separately through various editions. The resemblance in thinking and writing between Augustine and Aquinas is so marked, that it has been fancifully said that the soul of the one had passed into the body of the other. The disciples of Aquinas are called after him Thomists. Consult Werner, 'Der Heilige Thomas' (1858); Gibelli, 'Vita de S. Tomaso' (1862); Vaughan, 'St. Thomas of Aquin, his Life and Labours' (1872); Cavanagh (1890).

AQUINAS, Saint Thomas, Philosophy of. The philosophy of Saint Thomas Aquinas is the culmination of the philosophic efforts of the Christian schools of the Middle Ages. These schools, dating from their foundation in the reign of Charlemagne, set up a tradition of Aristotelian commentary and of independent speculative activity which, until the middle of the 12th century, were almost entirely circumscribed by the limits of dialectic, or logic. After the middle of the 12th century the physical and metaphysical works of Aristotle (q.v.) became known in the Christian schools of Europe, and with them were introduced Arabian commentaries which interpreted the text of Aristotle in a sense contrary to Christian theism. At the beginning of the 13th century a number of Christian teachers, especially Alexander of Hales and later, Albert the Great, undertook the task of expounding the theistic and spiritualistic philosophy of the Christian schools on the basis of Aristotle's physical and metaphysical doctrines, rejecting from the current Aristotelian teaching whatever they considered to be due to the influence of the Arabian commentators. These teachers prepared the way for Saint Thomas Aquinas (1225–74), whose chief merit is, not that he created a new method or contributed a new system of thought, but that he gave to the work of his predecessors and contemporaries a more compact synthesis and expounded this synthetic system with a simplicity and lucidity rarely to be met with in systems which like his carry complexity to a high degree of organic unity. Saint Thomas' most important works are the 'Summa contra Gentiles' and the 'Summa Theologiæ.' The former, begun at Paris about the year 1257 and completed some time between the years 1261 and 1264, was undertaken at the request of Saint Raymond of Pennafort for the purpose of defending the truths of Christianity against the Arabian pantheists and their followers. It is, therefore, apologetic rather than constructive in method and contents. The 'Summa Theologiæ' was commenced at Bologna in 1271, and was never completed. Unlike the 'Summa contra Gentiles,' it is constructive in aim and method. It is Saint Thomas' greatest work, his last and most important contribution to Christian theology and philosophy; for, although the work is entitled 'Summa Theologiæ' and is, in fact, a compendious treatise on all the questions of Catholic theology, it is also a summary of philosophy. It begins with the question of the existence of God, treats of the attributes of God, traces the origin of things from God and the return of man to God through Christ. It deals, therefore, with the creation and government of the universe, with the origin and nature of man, with human destiny, with virtues, vices and laws — with all the great problems of speculative and practical philosophy. It contains the maturer views of its author, so that whenever discrepancies occur between the doctrines of the *Summa* and the views expressed in his earlier works, the *Summa* is to be taken as the key to the mind of the master.

The method used by Saint Thomas in all his constructive works is a developed and perfected form of the dialectic method which we find anticipated in a short treatise by Gerbert (Pope Sylvester II, died 1003) and of which the first definite example is the *Sic et Non* of Abélard (d. 1142). In this treatise Abélard presents in contrast the affirmative (*Sic*) and the negative (*Non*) opinions of patristic writers in reference to each successive problem of Catholic theology, without, however, furnishing principles by which the discrepancies, real or apparent, are explained. This was, as far as we know, first done by Alexander of Hales (d. 1245), whose method was to set forth the arguments against his thesis, then the arguments for the thesis and finally to answer the objections. Saint Thomas practically adopted the method as he found it in use in the schools of his day, giving to each article discussed the recognized tripartite division *videtur quod non* (introducing objections), *sed contra* (introducing the argument for his thesis), and *respondetur ad primum*, etc. (answers to objections). Underlying this somewhat formal method was the principle which the schoolmen derived from Aristotle, that it is only by the dialectic discussion of the affirmative and negative sides of a question the truth is to be discovered and defined. In other words the faculty of the mind on which philosophy chiefly relies is not intuition but ratiocination.

In describing the content of Saint Thomas' philosophy one must advert, in the first place, to the Aristotelian mold in which all his philosophical doctrines are cast. For him Aristotle is the philosopher. On the questions of method and doctrine which divide the Platonists from the Aristotelians Saint Thomas unhesitatingly and invariably takes the side of Aristotle. In fact, he is the Christian Aristotelian in the sense in which Saint Augustine is the Christian Platonist. It would, however, be fatal to a proper estimation of his philosophy to overlook the elements in it which cannot be traced to Aristotle. He was no slavish imitator; he maintained as a principle of method that the argument from authority is (in philosophy) the weakest of all arguments. It was only in the age of decay of the philosophy of the schools, when the letter rather than the spirit ruled the tradition of Thomistic teaching, his name and the name of Aristotle were invoked as authority to put an end to all discussion.

To say that Saint Thomas was an Aristotelian means little when we remember that in his day there were mere followers of Averroes, materialists and pantheists, who might with equal justice claim to be representatives of the Stagyrite. Saint Thomas was an Aristotelian who brought to the elucidation of his Master all the tradition of Christian speculation from Justin, the first of the Apologists, down to his

own immediate predecessors and contemporaries. The thought which inspired the Christian philosophers was that above the order of natural truth, that is, of truth which can be attained and comprehended by the human mind unaided, there is another order of truth, the supernatural, which human reason cannot of itself attain, but which is known to us on the authority of divine revelation. Natural truth belongs to reason, and supernatural truth to faith. Christian philosophy from the beginning took its stand on the principle that these two orders of truth must, in some way, be capable of harmonious adjustment. Rationalism exaggerated the power of reason, mysticism tended to slight reason and to emphasize and unduly extend the scope of faith. Throughout the early Middle Ages these two tendencies were at war with each other in the Christian schools. It is one of Saint Thomas' chief titles to distinction that he united in his system what is true in rationalism with what is true in mysticism. The rationalism of Abélard obliterated all distinction between supernatural and natural truths when it treated mysteries of faith as if they were conclusions of theology and used the Scriptures as if they were sources of argument in philosophy. In an opposite sense, the mysticism of Erigena removed all distinction between the two orders of truth, when it maintained that even truths of the natural order are known to us by a special *theophania*, or divine manifestation. Saint Thomas taught that the two orders of truth are distinct; that our knowledge of supernatural truth rests on the authority of revelation, while our knowledge of natural truth rests on the evidence of reason. He maintained, at the same time, that they are consonant with each other, that since God is the author of all truth there can be no contradiction between what revelation proposes for our belief and what reason proclaims to be evident. This thought, namely, that revelation is reasonable and reason divine, crystallized the fundamental concepts of all the preceding systems of Christian speculation, reconciled mysticism with rationalism and gave permanent form to the *credo ut intelligam* and the *intelligo ut credam* of scholasticism. The reconciliation of reason with revelation is of interest not merely to the Christian Apologist but to the philosopher as well. For it is inspired by the desire to establish between the supernatural and the natural that relation of continuity which Greek philosophy at the highest point of its development established between the spiritual and the material.

To the controversy concerning the mode or manner of the existence of universals, which, during the 11th and 12th centuries, had been so prominently before the minds of philosophic thinkers, Saint Thomas contributed his doctrine of moderate Realism. The Nominalists contended that universals are mere names; the exaggerated Realists, influenced for the most part by Plato, maintained that universals are things really existing outside the mind as completely developed universal forms. The doctrine of moderate Realism (q.v.) is that, while universals are not mere names but real things, they exist outside the mind not as full-blown universals but only as potentially universal essences which receive their formal aspect of universality from the mind in the act by which it compares and discusses individual objects and abstracts therefrom the formally universal concept. Saint Thomas found this doctrine established in the schools of his time. He adopted it and gave to it, as to so many other tenets of the schools, its final and most clear-cut form.

One of Saint Thomas' most noteworthy contributions to philosophy was his elucidation in the Christian and theistic sense of some of the more obscure points of Aristotelian teaching. Having before him a translation made directly from the Greek text — a translation which is, indeed, far from correct, yet which in spite of many ludicrous verbal blunders is immeasurably superior to the translations made through the medium of Syriac and Arabic — he sought to free from the accretion of Neo-Platonic and Arabian commentary the original doctrine of Aristotle on the question of the nature of the Active Intellect. Rejecting what may be called the transcendentalist view, which held the Active Intellect to be something more than human, something akin to God and in some way common to all men, he defended the anthropological view, which held that the Active Intellect is a part of the individual soul, and, therefore, not common to all, but proper to each. In this way, he strengthened the defense of the immortality of the individual soul.

Saint Thomas founded a school within the schools. To the Franciscan teachers, such as Alexander of Hales, Saint Bonaventure and Roger Bacon, certain doctrines of Saint Augustine recommended themselves, to the detriment of the strict Aristotelianism which they professed. These Franciscan teachers were opposed by the Dominicans, who, like Albert the Great and Saint Thomas, recognized in the Augustinian doctrines in question an element of Platonism which was inconsistent with thorough Aristotelianism. The struggle between Augustinianism (q.v.) and Aristotelianism (q.v.) was waged in the schools, especially at Paris, during the first decades of the 13th century. The doctrines under discussion were mostly psychological: for instance, the Aristotelians maintained that there is but one substantial form in man, the soul, while the Augustinians maintained that there are several substantial forms; the latter contended that there is no real distinction between the soul and its faculties, while the former defended the real distinction; the Aristotelians maintained that there are subsistent forms, that is to say, purely spiritual created substances, without any matter, while the Augustinians taught that all creatures, even the angels, are composed of matter and form. On all these questions Saint Thomas took the part of the Aristotelians and thus became the leader in the Dominican, or, as it is sometimes called, the Thomistic school in the stricter sense of the word.

The controversies between the Dominican and the Franciscan schools brought out an important general trait of Saint Thomas' philosophy. Duns Scotus (1274–1308), the ablest of the Franciscan opponents of Saint Thomas, adopting the principle of voluntarism, brought to the surface the intellectualism which pervades Saint Thomas' speculative system. Saint Thomas pushed to its utmost consequences the *intelligo ut credam* of the earlier scholastics: he made intellect superior to will and sought in every thing to find an intellectual basis for be-

lief. Scotus maintained that on many questions of the highest importance reason fails to give a satisfactory explanation or proof and that we must fall back on will.

To say, however, that Saint Thomas was an Aristotelian in the Christian, as opposed to the Averroistic, sense; that he gave final form to the idea which inspired scholastic, and indeed all Christian, speculation; that he was a moderate Realist; that he held to the strict systematic Aristotelianism and excluded certain Augustinian and Platonic elements; that he was an intellectualist, is to give but a faint idea of his claims to pre-eminence as a representative of scholastic philosophy. Of him, as of all the great speculative thinkers, it may be said that the spirit of his work is more potent than the letter. To the modern mind, especially, he appeals in virtue of the spirit in which he undertook the work of adjusting his beliefs as a Christian to the scientific and philosophic thought of his age. To this task he addressed himself with an instinctive sense of completeness which impelled him to leave nothing incomplete or imperfect except so far as everything human is incomplete and imperfect. He brought to his task a mind appreciative of the value of truth wheresoever truth is found, whether in pagan, Jew or Gentile, and a belief — stronger in him than in any other Christian writer since Saint Augustine — that all truths and all contributions to knowledge, from whatsoever source they are derived, must be capable of harmonious adjustment.

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ARABESQUE, ăr'ą-bĕsk', a term applied to a particular species of decoration employed in Arabian and Moorish architecture. The followers of Mohammed, being prohibited by the Koran from representing the figures of men and beasts, endeavored to evade this law by inventing a series of monsters, griffins, dragons, strange birds and chimeras; affixing the head, wings and talons of birds to the bodies of lions, horses and other quadrupeds; and making the upper parts of children, men and beasts spring from among clusters of foliage and the like. In the Vatican there are paintings, executed by Giovanni da Udine from the drawings of Raphael, in this style, which are deservedly much admired.

ARABGIR, ă'rąb-gēr', or **ARABKIR**, town in Asiatic Turkey, 147 miles southwest of Erzerum. It owes its enlargement and prosperity to the Armenians, who form about one-fourth of the population, and it is especially noted for its manufacture of silk and cotton goods. Pop. about 28,000.

ARABI, ą-rä'bę, **Ahmed El** (usually known as Arabi Pasha), an Egyptian national leader: b. in Lower Egypt about 1837; d. Cairo, 21 Sept. 1911. He was the son of a common peasant, and, entering the army, rose to the rank of colonel and became the head of a party desiring to replace Turkish officers by Egyptians. On 9 Sept. 1881 he led the troops to the Khedive's palace and demanded the dismissal of the ministry, the convocation of a parliament and the increase of the army. The first two demands were granted, the third was referred to Constantinople; but the military party, which was mistakenly regarded by foreign observers as a Nationalist and Home Rule party, gradually became dominant, and Arabi was made War Minister. Flushed with success, he acted as if head of the state and rashly undertook to overthrow the Anglo-French control of the finances. In view of the situation a conference was held at Constantinople, and British and French fleets were sent to Alexandria; a massacre of Christians took place in that city (11 June 1882) and the British fleet, in the belief that the forts were preparing to fire, bombarded them, the French fleet withdrawing. Alexandria was burnt by the Egyptian troops, and the British expedition to Egypt followed. Arabi gave himself up and was tried for treason; acting on advice he pleaded guilty, an understanding having previously been arrived at with the Marquis of Dufferin, then Special British Commissioner, that the sentence would be commuted to banishment for life. Khedive Tewfik's desire was to put Arabi out of the way for good, and was only induced with great difficulty to consent to the arrangement. Arabi was sent to Ceylon, where he lived as a political prisoner on a small pension, but in May 1901 the Khedive Abbas Hilmi pardoned him and he returned to Egypt. A new generation of nationalists had grown up, which neglected him; observing the remarkable progress of his country during the 19 years of his exile, Arabi became converted to approve of British rule.

ARABIA, the peninsula in the southwestern part of Asia, called by the natives Jeziret el Arab, that is, the Peninsula of the Arabs; and by the Turks and Persians, Arabistan. It is encompassed on three sides by the sea, namely, on the northeast by the Persian Gulf and Gulf of Oman, on the southeast by the Indian Ocean and on the southwest by the Red Sea. Its extreme southern point, Ras-Arah (the Cape Saint Anthony of some maps), lies in lat. 12° 35′ N.; long. 44° 4′ E. Thirty miles west of it are the Straits of Bab-el-Mandeb. The extreme eastern point of Arabia, Ras-el-Had, stands in lat. 22° 23′ N., long. 60° 5′ E. A line drawn from the head of the Gulf of Suez to that of the Persian Gulf, and marking the limits of the Arabian peninsula on the north, will be found to run nearly in the 30th parallel of north latitude, but a portion of what is considered Arabia extends north of this. Arabia includes also the peninsula of Sinai, between the Gulf of Suez and that of Akabah. The whole area of the vast country thus described does not probably fall much short of 1,250,000 square miles.

Divisions.— According to Ptolemy, ancient Arabia consisted of Arabia Petræa, Arabia Deserta and Arabia Felix, a division likewise followed in modern times, but which is not only founded on erroneous principles, but unwarranted by the example of the inhabitants of the country. The name of Arabia Felix, or Arabia the Happy, is derived from an incorrect translation of the word *Yemen*, which does not signify happy, but the country lying to the right of Mecca, in the same manner as the Arabic term for Syria, Al-Sham, denotes the country lying to the left of that city. Arabia Petræa likewise has been erroneously translated Stony Arabia, the epithet Petræa having been bestowed on it by Ptolemy, from the once flourishing city of Petra.

The first of the divisions met with in proceeding down the Red Sea is Hejaz, which, as it includes the sacred cities Mecca and Medina, is always set forth conspicuously by Arab geographers. It extends a short way within the mountain barrier and terminates in the south in about lat. 20° N. Next comes Yemen which, according to some writers, embraces the whole of south Arabia; but the name is now generally used in a confined sense, Yemen proper occupying the southwest part of the peninsula, and comprising a Tehama or maritime lowland on the shores of the Red Sea, with an elevated inland district of considerable breadth. It contains the towns of Sana and Mocha. Appertaining to Yemen is Aden, now a free port in the hands of the British. Next Yemen, on the east, is Hadramaut, the western portion of which is a desert five days' journey in length. The limits of this province are, however, variously assigned by authors, some extending the name to almost the whole of the southeast coast, while others confine it to a district only 100 miles in length. Beyond Hadramaut, in the latter narrower sense, lies Mahrah, beyond which again extends the principality of Shejer or Shehr, at the eastern termination of which, near the coast, is the populous district of Dhofar, which has occasionally figured as an independent state. At the east angle of the peninsula is situated Oman. On the south shores of the Persian Gulf is Bahrein, from which, toward the head of the Gulf, extends the maritime district of Hasa, while at a short distance southwest in the interior lies the fertile district of El-Ahsa, the name of which is sometimes also given to the coast. The interior of Arabia from Hejaz and Yemen across to the vicinity of the Persian Gulf is comprised by Arab geographers under the single name of Nejed. The Sinaitic peninsula is called Al-Tih. The remaining divisions are Dahna, the great territory between Hadramaut, Oman and Nejed. Toward the north are the deserts of Sinai and those of Sham, Jezireh and Irak (Syria, Mesopotamia and Babylon). The two most populous districts are Yemen and Oman.

The climate of Arabia resembles that of Africa. The mountains obstruct the mitigating influence of the sea breeze; scorching aridity and barrenness characterize both high and low grounds, and the date palm is often the only representative of vegetable existence. There are even districts which in the course of the year are refreshed by only one shower of rain, while a sky almost perpetually unclouded overspreads the sterile plains. The short rainy season, which, in consequence of the shifting winds prevailing in the Red Sea, visits the west coasts in our summer months, fills with water, but only periodically, the depressions in the surface, or *wadis*, and a winter marked by slight frosts occurs in the table-lands of the interior and northeast. The simoom occasionally blows during the hot season, though only in the northern districts.

Productions.— Arabia is destitute of large forests, and plains of green turf have their place supplied by steppe-like tracts, which, however, covered with aromatic herbs, afford excellent pasture to noble breeds of horses. The terrace portions of the country, which enjoy a more temperate climate, exhibit a greater luxuriance of vegetation. Here the date and cocoanut palms and various excellent sorts of fruit flourish along with durra (a species of millet which is here generally cultivated instead of European corn), the finest coffee in the world (the staple commercial product of the country), and many aromatic plants and substances, such as gum-arabic, benzoin, mastic, balsam, aloes, myrrh, frankincense, etc. There are also cultivated in different parts of the peninsula, according to the nature of the soil and climate, beans, rice, lentils, tobacco, melons, saffron, colocynths, poppies, olives, the kath bush (*Catha* or *Celastrus edulis*), the leaves of which are in general use, like those of the coca in Peru, as an excitant, sesame, the castor-oil plant, etc. In its fauna also, as corresponding with the desert nature of the country, Arabia presents much of an African type. Sheep, goats and oxen supply man's immediate domestic and personal wants; the horse and camel are his faithful attendants on his travels; asses and mules, of a stronger make and better appearance than those of Europe, are common in the mountainous districts; the desert is inhabited by gazelles and ostriches hurrying rapidly from oasis to oasis; and the lion, panther, hyena and jackal crouch in ambush for the passing prey. Monkeys, pheasants and doves are the peaceful occupants of the fertile districts, in which, however, locusts frequently commit tremendous havoc. There are several species of serpents and lizards, and scorpions and poisonous spiders are numerous. Fish and turtles abound on the coasts, and pearl oysters in the Persian Gulf. Among mineral products may be mentioned saltpetre, mineral pitch and petroleum, which are found in the interior highlands, salt, sulphur (in Hadramaut), and several precious stones, as the carnelian, agate and onyx. Iron, copper and lead are far from abundant, and the country is also poor in the precious metals.

Population.— The population of Arabia has been estimated by some authorities at 12,000,000, by others at no more than 4,000,000. The former number is certainly too high. Palgrave estimated that Hejaz contained about 1,000,000 inhabitants, Yemen 1,000,000, Hadramaut and Mahra 1,000,000, Oman and Hasa 2,500,000 and Nejed 2,000,000. This would make a total for Arabia of about 7,500,000, which figure is probably too high, but in the absence of any regular census and with our total ignorance of a large part of the interior it is impossible to verify any statement on this point. The Arabs present, as a nation and as individuals, much that is peculiar both in their mental and physical

development. They are of middle stature, of a powerful make and have skin of a brownish color. Their features express dignity and pride; they are naturally active, intelligent and courteous; and their character is marked by temperance, bravery and hospitality, along with a strong propensity for poetry. On the other hand, they are revengeful in their disposition and predatory in their habits. The women have the entire education of the children in their early years. The most fortunate events in the estimation of an Arab are the birth of a camel, a mare of noble breed bringing forth a foal or a triumph achieved by a poet. The first religion of the Arabs, the worship of the stars, was supplanted by the doctrines of Mohammedanism, which succeeded rapidly in establishing itself throughout Arabia. Besides the two principal sects of Islam, the Sunnites (the most numerous) and the Shiites (on the east coast), there also exists, in very considerable numbers, a third sect, the Wahabees, which arose in the latter half of the 18th century, and to which the Bedouins of Nejed belong. There are also numerous Jews, who dwell among the Arabians and are chiefly employed in trade.

The whole of the west coast, comprising the districts of Hejaz and Yemen, and in quite recent times part of the east coast, namely Koweit, at the head of the Persian Gulf, and the district of El Ahsa, are more or less under the suzerainty of the Turks. The area of the western strip is about 200,000 square miles in extent, and has a population of about 1,130,000; while the eastern has an area of about 31,000 square miles and a population of nearly 200,000. Even in these districts, however, the chief offices of government are performed by the chieftains of the small territories into which the districts are subdivided. The most extensive districts politically united in the rest of Arabia are the kingdoms of Oman and Nejed, the former with an area of 81,000 square miles and a population of 1,598,000; the latter (the kingdom of the Wahabees) with an area of perhaps 200,000 square miles and a population of about 1,219,000.

The mode of life of the Arabs is either nomadic or settled, or in other words, they either live in tents and derive their subsistence from the rearing of cattle, wherever sufficient pasture is obtainable, and from the transport of caravans through the desert; or from the pursuits of agriculture and commerce. The nomadic tribes in Arabia are termed Bedouins, Beduins or Bedawins; those following settled occupations, Hadji and Fellahs. A considerable trade, partly overland, partly maritime, is carried on, chiefly in coffee, dates, figs, spices and aromatic substances of various kinds, though its present amount is scarcely a shadow of what it was in times previous to the discovery of the passage by the Cape of Good Hope. Commerce is partly in the hands of foreigners, among whom the Jews and Banians are the most numerous. The latter are a tribe of Indian merchants, who, however, only remain long enough in the country to enable them to return with wealth to their own land. At present the trade of Arabia is almost exclusively confined to exports of raw material or imports of foreign manufactures, domestic industry being scarcely able to supply the most necessary articles of consumption, and the inhabitants are thus rendered dependent on foreign nations for the greater portion of their manufactured commodities. The period of intellectual development among the Arabs is now indeed long past its zenith, but it does not appear yet to have sunk so low as is often assumed. Even in the desert children are taught to read, write and cipher, and in the towns there are higher schools for satisfying the taste for scientific pursuits. The political constitution of the Arabs is patriarchal, and based on a love of freedom. The titles of the chiefs of the tribes are emir, sheikh or imam, personages whose functions appear in general to be limited to the command of the army in war, the collection of tribute and the administration of law by the cadis or judges.

History.— The history of the Arabs previous to Mohammed is obscure, and, owing to their slight connection with the rest of the world, of little interest. The evidence of language, tradition and other things, establishes the fact that Arabia must have been settled at a very early date by two branches of one race. One of these branches inhabits the south and east of the peninsula (Yemen, Hadramaut and Oman), and considers itself as forming the "pure" Arabs, while to the other branch it gives the name of Mostareb, or "Arabified." The oldest traditions regarding the origin of the former branch point to an immigration from Africa which took place about the southwest corner of the peninsula, and the physical appearance and structure of the southern Arabs, the remnants of their dialect (which is now superseded by that of the northern branch), and various institutions and customs prevailing in the parts of Arabia inhabited by them, all confirm the notion that they were originally identical with the nearest inhabitants of Africa. The northern branch, on the other hand, though bearing an unmistakable affinity with the southern, shows (in its language and other respects) more traces of Asiatic than African influence. The Arabs of the southern branch were the first to attain any considerable political power. A kingdom belonging to this branch is said to have existed in the south for upward of 2,000 years, embracing, when in a flourishing condition, the whole of the south half of the peninsula, and sometimes extending its boundaries by conquest very much farther. There is no doubt that there was actually such a kingdom, called the kingdom of Yemen, and having its capital first at Mareb and afterward at Sana, both in the district of that name; but how long that kingdom subsisted cannot be determined. Its kings belonged to the Himyarite dynasty, but this designation Himyarite is sometimes applied by Arab writers to the ruling classes of the southern branch, and sometimes to the whole branch. The Yemenite kingdom was rendered subject by the Abyssinians for upward of 70 years in the 6th century of the Christian era, during which period Christianity was proclaimed in the land. Ultimately the heir to the throne of the Himyarite dynasty was restored through the assistance of Chosroes, King of Persia (605 A.D), but about 30 years later the kingdom was finally overthrown by the followers of Mohammed. Another Himyarite kingdom was that of Hira on the west shore of the lower Euphrates. It seems also to have extended at times to the region between the

Euphrates and the Tigris, so as to give the name of Irak Arabi to that district. The dates given for the foundation of this kingdom are widely different. Its overthrow is placed in the 5th century of our era. In the 1st century of the Christian era the Himyarite kingdom of Ghassan was founded in lower Syria and Hejaz. It lasted till the time of Mohammed. The last Himyarite kingdom that need be mentioned is that of Kindeh, which detached itself from that of Hira early in the 3d century, and lasted about 160 years. Its sway extended over northern Nejed. The divided forces of the Arabs could not always successfully resist the Roman arms, and though their country was never completely reduced to the condition of a province, yet the princes in the north at least lived in a state of dependence on the Roman emperors, and were regarded as their viceroys. In the south the Romans had no influence. An expedition was fitted out against Yemen in the reign of Augustus (24 B.C.), but it completely miscarried. With the decline of the Roman empire Arabia made vigorous struggles for independence, which could easily have been brought about by a union of the various tribes. But the Arabian peoples continued dispersed and broken, and passed many centuries in internal conflicts, during which the central highlands (Nejed) became the theatre of those chivalrous contests so celebrated by the native poets. Christianity early gained many adherents in Arabia, though it did not succeed in entirely banishing the ancient worship of the stars. Several Christian bishoprics were established, subject to the metropolitan at Bozra, in Palestine. The town of Elhira, near the Euphrates, contained many Arabian Christians and convents, and the reigning King, Ennomân-ben-el-mondsir, became a convert to Christianity not long before the time of Mohammed. The conflict of the Arabs with Roman despotism was more especially the cause of attracting to their country numbers of Christian sects, among others the Monophysites and Nestorians, seeking a refuge from the persecutions to which they were subjected by the maintainers of orthodoxy throughout the East. Jews also were very numerous in Arabia after the destruction of Jerusalem, and even made some proselytes, chiefly in Yemen. The wide differences between the various sects produced in the minds of many an indifference to all the existing religions, and was probably one of the principal causes that the doctrines of Mohammed found so speedy an acceptance in Arabia. With Mohammed a new phase commences in the history of the Arabian peoples, who are wont to designate respectively the periods before and after the appearance of the Prophet as those of ignorance and knowledge. Mohammed belonged to the Mostareb, and among them to the tribe of Koreysh, which had occupied a position of great influence in Arabia since the beginning of the 5th century, when it managed by craft to obtain possession of the city of Mecca, which was not only a city of great commercial importance, but was regarded as sacred by the Arabs on account of its containing the Kaaba. During the whole of the 6th century the Mostareb generally were increasing in power, and by the beginning of the 7th, when Mohammed had grown to manhood, they had absorbed the kingdom of Kindeh, and had extended their sway at the expense of those of Yemen, Hira and Ghassan. By the time of Mohammed's death, in 632, his religion had acquired a firm hold in Arabia, and after that event his successors, acting on the commands of the Koran, began to spread it by force of arms beyond the bounds of the peninsula. The nation, now for the first time acting as a body, played for several centuries an important part in the world's history, advancing in a career of victory beyond its natural frontiers, to found empires in three-quarters of the globe. The brilliant period of Arabian history, indeed, as regards foreign countries, came to a termination in Asia in 1258, on the fall of the caliphate of Bagdad, as also about the same time in Africa and Europe, in the latter of which the Moorish dominion was finally overthrown (in the kingdom of Granada in Spain) in the last decade of the 15th century; yet the epoch of the Arab sway must ever occupy a distinguished place in the intellectual history of mankind. The internal history of the country during its foreign conflicts presents little more than unimportant accounts of some Bedouin tribes, and the fortunes of the caravans which made the annual pilgrimage to Mecca. In 1517 Turkey subjected Hejaz and Yemen, and received the nominal submission of the tribes inhabiting the rest of Arabia. The subjection of Hejaz has continued down to the present day, with a brief interval in the latter half of the 16th century, and another longer interval in the 19th century, when the Pasha of Egypt was dominant in Arabia; but Yemen achieved its independence in 1630 and maintained it till 1871, when the territory again fell into the hands of the Turks. In 1839 Aden, in Yemen, was occupied by the British.

In the east Oman became virtually independent of the caliphs in the middle of the 8th century, and grew into a well-organized kingdom. In 1507, however, its capital, Maskat, or Muscat, was occupied by the Portuguese, who were not driven out till 1651. Oman was temporarily subjugated by the Persians under Nadir Shah in the first half of the 18th century. They were expelled by Saood, who was made imam of Oman, and under whom it extended its sway over part of the opposite coast of Persia as well as the islands lying between and over the coast of Zanzibar. Since 1867 the kingdom of Oman has been again confined to the mainland of Arabia. The appearance of the Wahabees about the middle of the 18th century is the first event since the time of Mohammed that affected Arabia generally. The moral effects of this event exercise still a powerful influence; the political were soon effaced by the ruler of the neighboring country of Egypt. Mehemet Ali, Pasha of Egypt, subdued the coast of Hejaz, as also several places on that of Yemen, and in 1818, by means of a great victory gained by Ibrahim Pasha, and the destruction of their capital city Derreyeh, put a stop to the further extension of the Wahabite power. He also expended large sums in the maintenance of his sway in Arabia, which secured to him the trade of the Red Sea. The events of 1840, however, in Syria, compelled him to concentrate his forces, and he soon found himself obliged, as thwarting the European line of policy, to renounce all claims to the territories lying beyond a line drawn from

the Dead Sea to the Gulf of Akabah. The Hejaz thus again became immediately subject to Turkish sway. Turkey afterward extended its rule not only over Yemen as already mentioned, but also over the district of El Ahsa on the Persian Gulf. During the great European War, strategic points of Arabia became scenes of active operations on the part of Turkish troops led by German officers against British domination in Egypt, the Sinaitic Peninsula being a dependency of Egypt, now a British possession. Hejaz and Yemen, on the west coast, and Hasa, on the east coast, were Turkish vilayets. There was an independent imam in Oman, and Aden and the surrounding district was a protectorate of Great Britain. The remainder consisted of several independent and semi-independent states under chiefs, elected or hereditary, bearing the title of emir, sheikh or imam. During the progress of the war, Arabia was the scene of revolts, uprisings and conflicts against Turkish authority and on 25 Oct. 1916 the Kingdom of Arabia was established with Grand Sherif Hussein Ben Ali as King, and Mecca as capital. On 3 Jan. 1917, the Grand Sherif of Mecca adopted the title of the King of the Hejaz, and the new kingdom was recognized by England, France and Russia. See WAR, EUROPEAN.

Modern Explorations.— Until about 1760 our knowledge of Arabia was based mainly on Greek and Latin writers such as Herodotus, Strabo, Pliny, Ptolemy and others. This information was meagre and not altogether reliable. The best sources were the Arabic writers and geographers, such as Hamadani's 'Arabian Peninsula,' Bekri and Yaqut's geographical and historical dictionaries. These works and others of their kind contain various fabulous and legendary traditions, based partly on native legends and partly on Jewish fancies. The Assyrian cuneiform inscriptions have yielded us much valuable material on the early history of Arabia. But above all we are indebted to scholars like Halévy, Müller, Glaser, Hommel, Winckler and others. The first European to engage in a scientific exploration of Arabia was C. Niebuhr, who, in 1761–64, at the order of the Danish government, undertook an expedition to the peninsula. In 1799, Reinand, an agent of the East India Company, followed Niebuhr and in 1808–11 the Russian scientist, U. J. Seetzen, undertook a similar journey of exploration and for the first time copied several south-Arabian inscriptions in the district of Himyar. A few years later, in 1814–16, one of the most distinguished of Arabian explorers, the Swiss, J. L. Burckhardt, journeyed to Hijaz and also to Mecca and Medina. His information is accurate, copious and interesting. Captain W. R. Wellsted, in 1834–35, made a tour of Oman and Hadramaut, and in 1838, C. J. Crittenden journeyed from Mokha to Sana and copied several south-Arabian inscriptions, which Rödiger and Gesenius undertook to decipher. In 1843, Adolf von Wrede, a German, visited Wadi Doan and other parts of Hadramaut and discovered and copied an important five-line inscription. In the same year T. J. Arnaud journeyed from Sana to Marib, the capital of the ancient kingdom of the Sabeans, and gathered about 56 inscriptions. In 1845–48 Wallin journeyed through Hayil, Medina and Taima. In 1853 Richard Burton, translator of the 'Arabian Nights' made a pilgrimage to Mecca and Medina and in 1877 and 1878 visited twice the land of Midian, in north Arabia. In 1861, Jacob Saphir, a Jew of Jerusalem, visited Yemen, where he formed several Jewish settlements, and other parts of Arabia. In 1862–63 W. Gifford Palgrave, an Englishman, journeyed from the Dead Sea to Oatif and Oman, visiting the northwestern territory between the Sinaitic peninsula, the Euphrates, Hayil, Medina, Nejed, and nearly all central Arabia, till then unknown. Central Arabia was visited by Pelly in 1865 and in 1869 Halévy, the great Orientalist and pioneer in Sabean philology, disguised himself as a poor Jew from Jerusalem, and penetrated Yemen and south Arabia. On this trip he copied about 700 inscriptions. He succeeded in reaching the south-Arabian Jof, the territory of the ancient Mineans. In 1870–71, H. von Maltzan made several trips from Aden along the coast, and, in 1876–78, Charles Doughty made a famous tour to Mada in Salih, Hayil, Taina, Khaibar, Boraida, Onaiza and Tayif. He unearthed several Sabatean, Lihyanian, or Tamudic, Minean and so-called proto-Arabic inscriptions. In 1877–80, the Italian, Renzo Manzoni, made three journeys to Sana, the Turkish capital of Yemen. Glaser, in 1882–84, made his first journey to south Arabia, where he discovered and copied numerous inscriptions and in 1883–84, with Euting, visited north Arabia, where they discovered the famous Aramaic inscriptions of Taima (6th century B.C.). In 1884–85, Glaser again visited southern Arabia and collected several Minean inscriptions. His third journey was made in 1887–88 and was remarkably fruitful, especially as far as epigraphical results are concerned. The inscriptions copied numbered over 400, the most valuable among them being the so-called "Dam-inscription," of 100 lines (5th and 6th centuries A.D.), and the "Sirwah inscription," of about 1,000 words (about 550 B.C.). Glaser's fourth journey was made in 1892–94 and was also rich in results. In 1893, Leo Hirsch visited Hadramaut, and so did Theodore Bent and his wife in 1893–94. In 1896–97, Count Carlo Landberg, a distinguished Arabic scholar, visited the coast of south Arabia, where he made special studies of the modern Arabic dialects there, in addition to other geographical and epigraphical researches. In 1898–99 the Vienna Academy sent an expedition to Shabwa under the direction of Count Landberg and D. H. Müller. Other expeditions have since been engaged in the work of exploration. The results of all these have been threefold: geographical, epigraphical and historical. These results have opened the way not only to fresh views and studies concerning the various ancient south-Arabian dialects, such as Minean, Sabean, or Himyarite, Hadramautic and Katabanian, but have also thrown unexpected light on the history of the old south-Arabian kingdoms and dynasties. These same discoveries have also added to our knowledge of Old Testament history and of Hebrew and comparative Semitic philology. See ARABIAN PHILOSOPHY; ARABIC LANGUAGE and ARABIC LITERATURE.

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ARABIA, Kingdom of. See HEJAS.

ARABIAN NIGHTS, The. 'The Arabian Nights,' or more properly 'The Thousand Nights and a Night' (Alf leilah wa-leilah), is a collection of stories in Arabic connected by a frame-story, probably Persian in origin and much older than most, possibly than any, of them. This frame-story, the distinctive feature of the 'Nights,' is essentially as follows: Shahriar, King of India and China, finding his wife false and that his brother and a genii are in like misfortune, kills the unfaithful wife and afterward each successive bride on the morning following the marriage. Public distress induces the vizier's daughter, Sharazad, to offer herself "to be a ransom for the daughters of the Mohammedans or the cause of their deliverance." She "beguiles the waking hour" of the king by beginning a story which she interrupts at a point of suspense. Her life is spared that she may continue it. She repeats the device, linking tale to tale or involving one in another, till at the end of the 1,001 nights she asks her life, receives favor and is made full queen.

A Persian collection of tales with the same frame-story is mentioned by the Arabian historian Masudi in 943; another historian, Abu Yakub al Nadim, writing in 987, says this collection was written by Princess Homai, daughter of Bahman, that it counted 200 tales distributed through 1,000 nights, and was a "meagre and uninteresting publication." It has perished, but it seems probable that some fifth part of the 'Nights' we know was derived from it, though with far-reaching modifications throughout. The frame-story is much older, possibly, if the ingenious identification of Sharazad-Homai with the Biblical Esther, attempted by the late Professor de Goeje of Leyden, be accepted, as early as 300 B.C.

Such a frame-story offers indefinite possibilities of extension and adaptation. Few manuscripts of the 'Nights' agree in their version of any single tale, in the order of the stories, or even in the make-up of the collection. We may suppose that some favorite and favored *rawi*, professional story-teller, found a recorder, or was asked by some wealthy admirer to furnish a record of his narrations, in which professional successors would make developments, suppressions, substitutions, as conditions changed or their genius suggested. The division into 'Nights' was obviously convenient for the professional narrator, living by his art. It is found in manuscripts of tales that do not form part of any regular manuscript of the 'Nights' known to scholars. The very popular story of Aladdin and the Wonderful Lamp is rarely found in such manuscripts; Ali Baba and the Forty Thieves, no less popular among the Bedawi, occurs in none of them. Sir Richard Burton, after translating one manuscript of the 'Nights' in 10 volumes, could fill six more with "supplementary" tales, often with equal literary claim to inclusion. We have not and are not likely to have any "canon" for 'The Arabian Nights.'

The stories of 'The Arabian Nights' are of many countries and times, but whatever their age or source all have been so transformed

that they are Moslem to the core, thoroughly Arabian in temper and in spirit. The scene is sometimes in China, India, even the land of the Franks; the time is often of the 8th or 9th century, or even earlier; but the *rawi* is as indifferent as his auditors to anachronisms, and will speak in these very stories of cannon or coffee, neither of which were known in Egypt till late in the 14th century. In one instance he names tobacco, which was not known till the 16th. The manners and customs assumed throughout are those of Egypt from about 1400 to 1550, and it was during this period, probably at Cairo, that the 'Nights' took their present form.

A *rawi* must be ready with a tale to suit any audience. He may have to gain his bread to-day in camp, to-morrow in the bazaar or the inn, among simple folk, or, if fortune smile, at the festivities of the rich. So a collection made from his lips or for his benefit will show wide variation in tone and theme. There are the old "Household tales," an Arabic Cinderella among them, animal fables, like those of Bidpai and Æsop, Bedawi adventures, lovers' romances, merchant voyages to strange and distant lands, adventurous wanderings in the spirit, and now and then, almost in the letter of the Odyssey, quests in the land of the Amazons and the isles of Wak-Wak in search of the lost beloved, tales of chivalry, taken from the historians, showing curiously the other side of the crusades and Moslem reaction to the Christian Church-Militant, some of them deadly serious, others frankly burlesque, picaroon tales of successful knavery, and finally a curious group in which the *beau rôle* is so persistently given to women, either some Princess Badoura or some slave Zumroud, that they seem designed less for any male audience than for idle hours of the *haremlik*. In nearly all the stories the actors live and move in momentary expectation of supernatural intervention. Any jar or well may hold an efrit or a genii, any lamp respond to a rub, any talisman to a turn, or rock to an "open-sesame." Any day may see the pauper a prince, the prince a pauper, the "sleeper awakened." Fancy sits here on her magic carpet and travels in a twinkling wherever she will to "expatiate free" without trammel from laws of probability, gravity or economics. There, in its power to give passing release from the cares and burdens of work-a-day life, lies the primary appeal of 'The Arabian Nights' to the Arab or Egyptian who reads or more probably listens to them.

The style of the 'Nights' is hardly ever studied, often it is slovenly to a degree suggested by none of the translations, meant, like its abounding poetical tags, to be spoken or chanted, rather than read. Character studies, such as the admirably comic barber, El Samet, are very rare. But there is a verve and fire of imagination in the stories that has defied even inept translators to quench, though the interest that these tales awaken in a western man or boy, Oriental scholar, or plain reader, must at best be different from that which they arouse in those to the manner born when heard on Arabian nights.

First to introduce the 'Nights' to western readers was the French traveler, Abbé Galland. His adaptation and transmutation of the manners and speech of Cairo to those of Versailles, appearing in successive volumes from 1704 to 1717, won immediate popularity. Its first English echo was Addison's retelling of the story of Alnashar in the *Spectator* of 13 Nov. 1712. The popular English versions of the 'Nights' are humbler adaptations of Galland's paraphrase, whatever their pretention of "revision" and new translation from the Arabic. This was first seriously attempted by the Irish novelist Henry Torrens, who issued in 1838 a translation of the first 50 'Nights,' made at Simla and, though abounding in errors, conveying more of the spirit of the East to English readers than does any of those that have followed. In 1839 the distinguished Egyptologist Lane at Cairo issued the first volume of a translation finished in 1842, and Torrens abandoned his work; unfortunately, for, though Lane knew far more Arabic, he had less imagination and was more attracted by the sociological interest of the 'Nights' than by their power to work illusion. His version is very scholarly, very labored. It omits or softens with over-anxious care all that seemed likely to offend European morals or even Victorian conventions. John Payne's privately printed version (1882–84) is complete and written with purely literary aim, solely for the story's sake, but with more of the temper of mediæval Europe than of Egypt or Arabia. It is least happy in its rendering of the simplest folk-tales. Sir Richard Burton knew more of the 'Nights' and of the life they depict than any of his predecessors. His translation (1886–88) is also complete for the manuscript selected. Six supplementary volumes contain stories found in others only. Burton's notes bring together a vast deal of curious information, hardly to be found elsewhere, but the English reflects the extreme eccentricity of the translator, even to the point of perversity; and though his work was pruned for a household edition, of matter that could not be published, it has not become popular. The judgment of the multitude is not altogether unenlightened in continuing to abide faithful to the Gallic English of the adapters of Galland's adaptation, so long as their desire is less to know of Arabian manners or Egyptian ways than to be made fancy free. For such no literal translation can serve, least of all in case of the frequent lapses into verse. Some adaptation there must be. English readers have still to await a satisfactory re-creator of 'The Arabian Nights.'

The stories in any of their versions are of very varying interest. Beside Ali Baba and Aladdin, which may lack a bibliographer's title to inclusion but have every other, it is enough to recall the names of Sindbad the Sailor, of Abou-Hassan, the Sleeper Awakened, of the scapegrace Ali of Cairo, of Noureddin and Bedreddin, of Hassan of Balsora, Joudar, Alishir, Zumroud, Camaralzaman, Badoura, Gulnare, Marouf, prince of ready-tongued impostors, the Hunchback and El Samet, the barber of unquenchable garrulity; of the gracious Peri Banou, of the Porter and the Three Ladies of Bagdad; of the Magic Horse, the Magic Carpet and the City of Brass, to realize how large is the debt of English literature and English readers to 'The Arabian Nights.' They have made it hard to think in terms of

historical reality of the Caliph Haroun al Raschid.

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ARABIAN PHILOSOPHY. Speculative activities were stimulated into action among the Arabians with the appearance of sects in the world of Islam. As soon as Mohammedanism came in contact with older civilizations, notably with that of Persia, the ideas and mental habits of the new converts created a spirit of investigation into the doctrines of the Koran, which until then had been accepted in blind faith on the authority of divine revelation. The first manifestation of this spirit was the coming into existence of the sect known as "Kadariyah" (from the Arabic *Kadara,* to have power), whose partisans proclaimed the freedom of the will, in contrast with the "Jabariyah" (*jabara,* to force, to compel), who defended the generally accepted belief of the orthodox that man is completely dependent upon the divine will, and that not only his destiny but also his conduct is determined, and his own will does not count.

From the "Kadariyah" developed the school of theologians known as the Motazilites (from *itazala,* to separate oneself). In addition to the doctrine of free will the Motazilites taught that God is an absolute unity, and no attributes can be ascribed to him. They further asserted that revelation is a natural product of the human faculties; that all knowledge necessary for the salvation of man emanates from his reason. To defend their doctrines against the attacks of the orthodox, the Motazilites elaborated a system of a rational theology, which they designated "Ilm al-Kalam" (science of the word). Its professors the *Motekallamin* (known in Hebrew as *Medabberim* and as *loquentes* in the Latin versions) may be compared with the scholastics of the Catholic Church. After the introduction of the Greek philosophy among the Arabians, the *Motekallamin* directed all their efforts against the philosophers. Their principal aim was to defend against the Peripatetics the creation of matter, and the existence of a god who exercised a direct action upon the making and the keeping of the world. To that end they adopted the theory of atoms as enunciated by Democritus. They taught that space is pervaded by atoms possessing no quality or extension, and time was similarly divided into innumerable instants. The atoms were originally created by God, and are created now as occasion seems to require. Bodies come into existence or die through the aggregation or disintegration of these atoms. There is no causality in the laws of nature, God alone is the cause. The supposed uniformity and necessity of causation is only an effect of custom; the universe could be entirely different from what it is.

In reaction against both the *Motekallamin* and the philosophers there arose, in the land of the Magis, the mystic sect of the "Sufis" who subsequently exercised a great influence on the Islamic world. The Sufis protested against all philosophical inquiry, and declared theological knowledge to be far inferior to inward perception, or mystic intuition acquired through religious ecstatics. From the conflict of these divergent forces there arose, in the 9th century, the tendency of thought represented by the philosophers of Islam. The initiators of this tendency were Syrian Christians, who, encouraged by the enlightened caliphs of the Abbasside dynasty, and especially by Almamun (813–33), transplanted Greek science and philosophy to the Arabian soil. In addition to works of science, they translated the 'Timæus,' the 'Laws' and the 'Republic' of Plato, and when, attracted by the medical treatises of Galen, they were led to the study of Aristotle, the Arabians translated not only the genuine writings of the Stagirite, but also the so-called 'Theologia Aristotelis' which was merely a compilation from the 'Enneads' of Plotinus, and the 'Liber de Causis' which was a compilation from the 'Elements of Theology' of Proclus. The erroneous attribution of these two works to Aristotle, together with the translations of the neo-Platonic commentators, such as Porphyry and Ammonius, imparted from the beginning to Aristotelian teaching a neo-Platonic meaning; and even those of the Arabian philosophers who came to be recognized as the most faithful exponents of Peripateticism were not entirely free from the influence of neo-Platonism.

Among the Arabian philosophers of the East the most prominent were Abu Jusuf Ja'Kub ben Ishak al-Kendi (d. about 870), Abu Nasr Mohammed al-Farabi (d. 950), Abu Ali ibn Abdallah Ibn Sina (Avicenna, 980–1037) and Abu Hamed Mohammed Al-Ghazali. Of the 200 treatises which Al-Kendi is said to have composed on all themes of science and philosophy, there remained only a few works on medicine and one on the astrological-astronomy of his age, in which he expresses the opinion that all things are bound together by harmonious causal relations, that each, when completely conceived, must represent as in a mirror the whole universe. Al-Farabi gave the tone and direction to nearly all subsequent speculations among the Arabians, and his works on logic became authoritative among the Latin schoolmen. Among the contents of his metaphysics mention is to be made of his proof of the existence of God, which was employed by Albertus Magnus and later philosophers. Taking for base the Aristotelian principle that all change and all development must have a cause, Al-Farabi distinguishes between that which has a possible and that which has a necessary existence. If the possible is to exist in reality, a cause is necessary thereto. As the world is a composite it must have had a beginning or was caused; but as the series of causes and effects can neither recede *in infinitum,* nor return like a circle into itself, it must depend on some necessary link, and this link is the first being (*ens primum*). This first being exists necessarily; it is the cause of all that exists. It is simple and unchangeable. In his teaching respecting that which is caused from God, Al-Farabi follows the neo-Platonists. His fundamental conception is expressed by the word *emanation.* Prophecy is in Al-Farabi's opinion merely a natural manifestation of the intellect. It emanates from a soul of purified reasoning powers; the soul associates itself with the active reason and receives from it

aid and instruction. Man's supreme aim is to elevate his capabilities to the highest degree of perfection attainable. Contemporary with Al-Farabi was the semi-religious and semi-philosophical society of the "Brethren of Purity." The treatises of this society afford a kind of encyclopedic survey of the sciences of all nations and religions known to their time. Their philosophy of nature, however, ends almost entirely in psychology. The soul is the real being of man which has developed on a mystic path of ascent from the lower natural orders through the animal stage to an increasingly higher grade of perfection.

Avicenna exercised a great influence in Europe both by his medical canon and by his works on logic and metaphysics. In the domain of the latter he set out from the doctrines of Al-Farabi, but modified them by omitting many neo-Platonic theorems and approximating more nearly to the real doctrine of Aristotle. He taught that while all things are primarily traceable to the agency of an immediate influence of such a diety, inasmuch as the immutable cannot itself create substances subject to the element of change, the first and only immediate product of God is the *intelligentia prima*, from which the chain of emanations extended through the various celestial spheres down to our earth. But the issuing of the lower from the higher is to be conceived not as a single, temporal act, but as an eternal act. The cause which gave to things their existence must continually maintain them in existence. However, notwithstanding its dependence on God, the world has existed from eternity. Time and motion always were. Avicenna distinguishes a twofold development of our potential understanding into actuality, the one depending on instruction, the other rare and dependent on immediate divine illumination.

Ghazali, the last philosopher of the East, marked a reaction of the exclusive religious principles of Mohammedanism against philosophical speculation. After having expounded in his 'Makasid al-Filasafah' (Tendencies of the Philosophers) the teachings of the Peripatetics, he shows in 'Tahafut al-Filasafah' (Destruction of the Philosophers) their weakness. He makes a critical analysis of 20 points — 16 of which belong to the domain of metaphysics, and four to that of physics — and demonstrates their contradictions. Like the *Motekallamin* he rejects the theory of causality, and asserts that there is not necessarily any connection between phenomena that usually occur in a certain order. This indictment against liberal thought was afterward refuted by Averroes, who reproaches Ghazali with duplicity; but it sounded the death knell of the study of philosophy in the East.

The Arabian philosophers of the West showed greater independence than their predecessors of the East and freed themselves more from the theological bias. The first among them was Avicebrol who, considered by the Christian scholastics as an Arabian, was identified by modern scholars with the Jewish famous poet Ibh Gabirol. His main thesis in his work, which was rendered into Latin in 1150 under the title 'Fons Vitæ,' is that the *materia universalis* is the substratum of all that exists; one and the same matter runs through the whole universe from the highest limits of the spiritual down to the lowest limits of the physical, excepting that matter the further it is removed from its first source becomes less and less spiritual. Though essentially a neo-Platonist, Avicebrol departed from the pantheistic emanation doctrine, originating that of the divine will.

An exponent of a purer Aristotelianism was Abu Bekr Mohammed ben Jahya Ibn Badja (d. 1138), known to the Latin world as Avempace. Besides commenting on various physical treatises of Aristotle, he composed the 'Conduct of the Solitary,' in which he treats of the degrees by which the soul rises from that instructive life which it shares with the lower animals through gradual emancipation from materiality and potentiality to the acquired intellect, which is an emanation from the active intellect or Deity. This idea is more fully developed by Abu Bekr Mohammed ben Abd al-Malik Ibn Tofail (1100–85) known as Abubacer, in his philosophical novel 'Hay ben Jokdan' (the Living, the Son of the Waking One). Borrowing from Avicenna the allegorical character of the ideal man Hay ben Jokdan, Ibn Tofail describes the development of a thinker growing up far from all human intercourse on a lonely island. He creates for himself the conditions of material existence, and in his mature age is led by the contemplation of nature to the vision of God. He then meets a philosopher who has risen beyond the limitations of human society, and the two resolve to communicate this pure knowledge to the people; soon, however, they realize the vanity of the undertaking, as the people are ripe only for Mohammed's allegories.

The last and greatest philosopher of the West was Abu al-Walid Mohammed Ibn Roshd (1126–98), known as Averroes. While his predecessors sought more or less to attenuate the theories of Aristotle when they were in direct apposition to religion, Averroes endorsed them to their utmost, and seemed to take pleasure in emphasizing them. In his opinion science is the sole arbiter in matters of this world; and religion is not a branch of knowledge to be reduced to propositions and systems of dogma, but an inward power, an individual truth which stands distinct from, and not contradictory to, the universalities of scientific law. The perplexing problems of creation, providence and immortality were solved by Averroes in a true Aristotelian spirit. With regard to creation he goes still further than Aristotle himself, declaring that not only is matter eternal, but that form even is potentially existent, otherwise there would be creation *ex nihilo*, which is inadmissible.

With Averroes the Arabian philosophy came to a close in the Islamic world, but it exerted for centuries great influence on Christian schoolmen. Though the Arabian philosophers can lay no claim to originality, civilization owes them a debt of gratitude for having preserved the writings of Aristotle the study of which led to the birth of the modern philosophy.

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ARABIC LANGUAGE. Among the languages termed Semitic, subdivided into Northern, embracing Aramean, Canaanitic, and Hebrew, the Babylonian and Assyrian, and Southern, including Arabic, Himyaritic, Geez or Ethopian, the Arabic in its historical growth and development and its present-day wide diffusion and prominence, is the richest and most important of the entire group. Compared with its sister idioms, it has the merit of modernity and completeness. Regarded as an ancient tongue, it has the vigor and freshness of youth. In the earlier times, as the Bible and the inscriptions show, the constant migrations from central Arabia into Babylonia, Egypt, and south into Yemen and Abyssinia brought about reciprocal changes in dialects and customs. It was Schrader's view, contested by other authorities, that Arabia was the starting-point of Semitic culture. Historical and geographical conditions, however, tended to preserve its earliest roots and forms until the 6th or 7th century of our era, being more fortunate than Aramean and Canaanite and the Phœnician in their closer contact with foreign nations that was disturbing and led to destruction. Another happy circumstance was the fixation by the Koran of the Koreish dialect, the tribe settled in and around Mecca, and from which branch Mohammed sprang, as the future literary language of the whole nation. Even if with Nöldeke we deny the theory that classical Arabic is nothing but the dialect of Mecca which the Koran brought into fashion, we must admit how vital the Koran has proved, despite some variations from classical rules, as the storehouse of the national tongue. Mohammed's grammatical and orthographic errors were later sanctified and introduced into the language as standard authority. Hence the essential unity of Arabic wherever spoken or written. From the mouth of the Tigris, through all Mesopotamia, Syria and Palestine, in Arabia proper, Egypt and north Africa as far as Morocco, the language is the same, although some decay in inflection is to be observed. Wright claims its purest form is found among the Bedouin and its most corrupt on the Island of Malta. In its long stretch of history it has not been untouched by foreign influences; it has absorbed in particular Greek elements of culture, but not to the same extent of assimilation as an Indo-Germanic dialect would have done. Its antiquity and influence are shown in the earliest records of the Old Testament in grammatical forms and words, while in later centuries Arab wisdom was personified in the Queen of Sheba, in the friends of Job and in Solomon's own sagacity being compared to that of the Arab.

It was the Koran and the religion of Mohammed which made Arabic one of the chief languages in the world and subjected half the earth to the sway of Islam. The linguistic changes that naturally followed the military domination of the 1st century disappeared a century later when Arabic grammar was constructed so firmly as to undergo subsequently no essential variation. The zeal of Arabic philologists has opened to the world the vocabulary of the language, its wealth of words and ease of modification, which is the more wonderful when we consider the simple conditions of Arab life and how monotonous the land. The grammatical forms, too, are exceedingly rich, with the lavish development of broken plurals and verbal nouns, while it possesses the poetical freedom that seems the characteristic of the Hebrew. It is adapted as well for business as for society, and for abstract subjects in particular. Minor Arabic dialects developed with time and diverged one from the other. The present speech of Egypt and the African coastal lands — the Maghrib — from Tripoli to Morocco have been made intelligible by special grammars. Maltese for nine centuries has been isolated from the influence of literary Arabic and exposed to that of Italian, and forms an interesting language for the philologist. Nöldeke asserts, however, that with all their variations these dialects do not differ as much from classical Arabic as French and Rumanian do from Latin. Despite the puzzling appearance to the novice of Arabic script, it is comparatively easy to learn. The real mystery of the Semitic languages, seen in the Arabic in its most bewildering form, is the triliteral root which consists of three consonantal letters. While the vowels are only subordinate, expressing the word's modifications, the consonants give its meaning.

In the group of Arabic is to be included the South Arabian or Himyaritic, called also Sabæan, which extends along the south coast of Arabia from the strait of Bab-el-Mandeb on the west to the mouth of the Persian Gulf on the east. Inscriptions found in great numbers particularly in the province of Yemen are in the ancient Himyaritic, dating to the 3d and 4th centuries of our era. None of the monuments in that dialect are older than the 7th century. The paucity of vowels in the inscriptions renders its knowledge more difficult, but the resemblances to Arabic are marked. Geez or Ethiopic is the language of the Abyssinians — its modern dialects are found in the Tigré and Amharic in the mountainous regions southwest of Arabia. The oldest Ethiopic monuments — apart from the Ethiopic version of the Bible — are a few inscriptions which date from the first five or six centuries of our era. When the ancient language had died out among the people it was still cultivated by the priesthood. Its literature is largely modern, consisting of translations from the Coptic and more often from the Arabic from the 13th to the 16th centuries.

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ARABIC LITERATURE. While it is only the last century before Mohammed which has left a few traces of early Arabic literature, from the era of the prophet of Islam it grew with marvelous rapidity to become one of the most widely cultivated in successive ages. An outgrowth of the wandering Bedouin of the desert, it was to include nearly all the branches of human knowledge and research. Theology, medicine, philosophy, philology, history, mathematics, geography, astronomy and poetry, in particular, were extensively represented, even if the modern world has had, as yet, only an introduction to these treasures, which were less cultivated after the 14th century. The beginnings sprang from the desert, when the Bedouin with his camel, long his only steed, his nearby herbage and frequent encampments, became rhymster and balladist in a fashion. His subjects were limited — the face of some dear one, the abandoned camp and its lost treasures, the strife over camel or caravan — nothing very monumental or superhuman as might be traced in the early literary effort of the Indo-European. The primitive Arabic poems in quaint measures are satires and sharp epigrams, passing from tribe to tribe of a common origin, and composed by the *Sha-ir*, sage and diviner as well. Of such productions nothing remains. Popular songs orally transmitted in memory of victory over the Romans were soon forgotten, for nothing was written in those times.

It is not surprising that the most ancient of the Arabic poems date only from the 6th century of our era when Nabatean travelers brought the Estrangelo alphabet from Syria and applied it to the Arabic. The poets of the desert traced their rhymes and metre to the soothsayer's formula and chant; the measure was to be changed as new conditions of life arose with music and the dance, and the bustling town supplanted the wilderness.

Out of the pre-Islamic period the earliest poems comprise the seven *mu-allaqat* or literally the "suspended" — a term of later origin to indicate the high honor in which they were held, like some glittering pendant; they were also called a "necklace of pearls." The word is also held to signify "excellent." The seven poets whose names were thus strung together are Imru'u'l-Qais, Tarafa, Zuhair, Labid, Amr, Antara and Al-Harith. In the opinion of some the two last are Nabigha and A'sha. They created the *qasida*, with its definite rules and forms. It treated of the abandoned camp, and those who had forsaken it. Some love theme is interwoven and then the hard desert journey is mentioned, with the faithful steed's desperate plight. The last lines dwell on the glory of the ruler before whom the poem is recited and from whom a gift is expected. Of these the name of Antara survives in the Romance of Antar — a true desert poet, as contrasted with the courtier poet Nabigha or with Imru-ul-Quais of royal lineage and regarded by Mohammed as best of all.

Other pre-Islamic poems preserved are the *Diwans* (anthologies arranged according to the alphabetical order of the rhyme) of the six poets brought together by the grammarian Al-Asma'i, preserved in revised form by a learned Spanish Arab of the 11th century, and published by Ahlwardt. In the same class is Al-Mufaddal's collection of poems, *Mufaddaliyyat* in one volume in the 11th century, of whose publication Thorbecke has made a beginning; and also the *Jamharat Ash'ari al Arab*, quoted in the 11th century by Ibn Rashiq and printed at Bulaq. Better known is the *Hamasa* or anthology of war-like exploits, by Abu Tammam, translated into German by Rückert. Leyden has a manuscript copy of a work of the same name and kind and dating from the same century, the ninth, compiled by Al Buhturi. Wright has issued a fragment of Sukkari's stories of brigands. But the most valuable source to early poems and poets is the *Kitab-al Aghani* (Book of Songs) by Abul'l-Faraj, published at Bulaq in 20 volumes, with an additional volume by M. Brünnow from manuscripts discovered in European libraries. Sukkari has also collected poems of the Hudhailites, who dwell southeast of Mecca, which have been studied and translated in part by Kosegarten, Abicht and Wellhausen. In addition to their anthologies many warriors sang their own deeds in love and war, like Ta'abbata-Sharran and his companion Shanfara, Urwa ibn al-Ward, Dhul-Asba, Al-Hadira, Abid, Hatim, Umayya, whose subjects were religious, and who died in 630. Of a religious turn and famous in his day was Al-Asha. Al-Khansa was renowned for her elegies, a necessary part of funerals, and whose composition was confided to women. There were a number of Jewish poets in that early period, whose colonies dated from the Roman conquest of Palestine; local legend asserts an earlier origin. Their language had been Arab, but they had retained their religion and were propagandists in a way as Arab tribes associated themselves with them. The greatest was Samuel ibn Adiya, and next to him in fame was possibly Al Rabi, whose sons were bitter enemies of Mohammed. Christianity had made proselytes in Arabia, with churches and monasteries in Syria, with the constant caravans of northern Arabs, while Mesopotamia was wholly Christian. Adi ibn Zaid was the most famous of the Christian poets, coming from Hira, with its mixed elements of Arameans and Arabs. Of the prose of these early centuries, there are no traces extant, as nothing was written or deemed worthy of such honor. The literary art which attained later such magnificent development was limited to stories and recitals of martial deeds, to proverbs and legends. With the Koran began a new period of Arabic

thought. Whatever elements, whether Jewish, Christian or a blend of the two, like the Essenes, were at the basis of Islam, the Koran founded the classic literature of the Arabs. Revealed in bits and fragments, with its style differing according to the periods of the prophet's life at which he was inspired, written throughout in rhymed prose, and finally edited under Caliph Uthman, with its chapters or *suras,* excepting the first, arranged artificially according to their length, the work became corner stone and temple, foundation and edifice, authority and inspiration to worshipper and worker. All copies of the Koran now existing are copies of Uthman's edition — other texts were done away with by that Caliph, except the authoritative text of Abu Bekr, which was soon afterward destroyed by the governor of Medina. Unanimity and unity had been preserved. In the largest measure Arabic literature is the Koran, studied, interpreted in prose or verse, eulogized, made the point of departure for thought in a thousand fields, all closely connected with the history of the Arab people at home and in their conquered realms.

Under the Ommeyyads, when less simplicity prevailed than under the first four caliphs, as town life grew more attractive, the old forms of poetry were maintained with all their artificial character. Three brilliant names appear in this period — Akhtal, Ferazdaq and Jarir, whose merits were a constant source of dispute at the court. Minor poets were numerous. Many, the best known of whom was, Ajjaj and his son, Ruba (edited in 1903 by Ahlwardt and translated by him a year later), revived the *rajaz,* a very simple prosodic metre, used for improvisation in pre-Islamic times. With the rise of the Abbasside line and the wider diffusion of Persian influence, a new literary period began. Bagdad was founded, and became a famous centre. The Arab gave way to the Persian in poetry, theology and law. If Arabic now became the sole language of the vast empire of the caliphs, it was written and spoken by men who were Arabs only by education. Changes in the character of poetry and its subjects were soon to follow. Less and less attention was paid to the quarrels and exploits of the tribes and more to general culture and interests. Among the large group of poets, the most distinguished was Abu Nuwas, born in the heart of Susianà about 756. He practised every form of Arabic verse with a range and ability that gave him fame. Others of more or less prominence were Muti ibn Ayas; the blind Bashshar, ibn Burd (d. 783), Abu Dulama, Marwan (d. 797), a Jewish writer from Khurasan; Ibn al-Ahnaf, Muslim (d. 803), who at the point of death caused a rough copy of his poems to be cast into the river; Abul 'Atahiha, Di'bil (d. 850), Ibn al Mutazz, a caliph's son who was a dainty poet and wrote the first great Arabic work on rhetoric. The list could be greatly extended. The provinces claimed a full share of writers, some of whom rivaled those of the capital, names like Ismail of Bassora (d. 789). Dik-al-Jinn of Syria (d. 809), Al-Ma'arri born in Syria 973; Abu Firas, of princely family; Al Nami of Aleppo (d. 963); Tughra'i, born at Ispahan (d. 1121), Al-Wawa, of Damascus, Al Haziri of Turkish origin (d. 1235). The most famous representative of the provinces was Mutanabbi, Syrian (b. 905), who became so popular that 40 commentaries were written to explain his verse. Persia had a group of poets in Arabic, among whom can be mentioned Al-Busti (971–1010), who composed in prose and verse; Al-Abiwardi, poet and scholar; Al-Khayyat (1058–1123, whose 'Diwan' was widely read in the Middle Ages; Al-Ghazzi (1049–1130), a Palestinian; and the most illustrious of all Sadi (d. 1291), who wrote Arabic odes as well as his immortal 'Gulistan' and 'Bustan.' Besides flourishing in Syria, Persia and Egypt, Arabic poets were found in Spain and Sicily. In rhymed prose Al-Hamadhani (968–1008) wrote his 'Maquamas,' or lectures with rare skill. Al-Hariri (1054–1122) was the most brilliant in this field. As late as the last century he was imitated by the Sheik Nasif (d. 1871). Tales in a similar vein, written in the 9th and 10th centuries, are found in the anthologies. Stories, too were borrowed from the Pehlevi version of Bidpai's fables in Arabic translation by Ibn Muqaffa in the 8th century, under title 'Kalila wa Dimna,' and from the Indian through the Persian, made as early as the 9th century, of 'The Book of the 1001 Nights,' which took its present form with local variations about the 13th century.

During the dynasty of the Abbassides the science of languages was studied as zealously as poetry. The schools of Kufa and Bassora furnished a long array of authors in Arabic, with their grammars, word-studies, philological treaties on the Koran. The Nizamiyya University of Bagdad proved a centre of research for studies in poetry, rhetoric and lexicography chiefly by scholars of Persian origin. History, which began with works devoted to the sway of Mohammed, was soon concerned with the biography of the prophet as the tradition was more closely investigated. Early historians were Ibn Ishaq (d. 768), the great part of whose biography of Mohammed, preserved in Ibn Hisham's compilation, was translated into German by Weil, and Al-Waqidi (747–823), whose work was issued at Calcutta by von Kremer. There were many others who followed in the field of history, some very celebrated. Tabari (838–923), is probably the most important; his 'History of the Prophets and Kings' is the most ancient record in its line extant. Mada'ini's 'History of the Caliphs,' issued before Tabari, is known only in the selections given by later writers. Historical anecdotes and legends were embodied in a number of works. Out of this period, too, comes the 'Fihrist,' a bibliographical treatise of writings which have disappeared, owing largely to the destruction of the Bagdad libraries by the Mongols in the 13th century and by Tamerlane in the 15th. Provincial histories, biographies of Saladin and others, autobiographies which began with Ibn Munqidh (1095–1188) were written, while jurisprudence attracted numerous authors, commentators on the canonical books, criticism of the authorities of the tradition, and an endless array of treatises on Moslem law in its varied ramifications, and on dogmatic theology and mysticism. Translations from the Greek formed an integral portion of Arabic literature. Greek works on philosophy and science had been translated by the Syrian monks and were thus reproduced by the Arabs. Caliph Al-Ma'mum by founding a

university at Bagdad was the first to give distinct impetus to Arabic science which through Moslem Spain was to arouse all Europe. Then followed a rapidly increasing mass of books on philosophy, mathematics, astronomy and astrology, geography, medicine, alchemy, encyclopædias, whose influence was widely extended through the then known world. One famous name may be mentioned, Ibn Khallikan (1211–1282), whose anecdotal biographical work, 'Obituaries of Great Men,' was translated into English by de Slane (London 1842–71).

It is difficult to do justice to the strength and character of Arabic literature in the centuries of its fullest blossoming. Rulers as a class vied with each other in establishing schools and colleges. Besides Bagdad, Bassora and Kufa, Aleppo, Ispahan and Samarcand became homes of science, while Cairo, Fez and Morocco contained academies of learning, with rich libraries, the precious storehouses of knowledge for later times. Cordova was to Europe what Bagdad was to Asia for several centuries. Students from other parts of Europe journeyed to the Arab schools in Spain to learn particularly medicine and mathematics. In arithmetic, geometry and astronomy the Arabs were the pathfinders of their day. Arab Spain furnished a remarkable contrast to the spectacle of comparative ignorance in the rest of Europe. In mathematics their influence was of signal character. They added the decimal system and the Arabic numerals, whose origin, however, can be traced to India; they simplified the trigonometry of the Greeks and widened the application of algebra. In the line of inventions and discoveries they merit much distinction; they brought paper from Asia and were the first to employ cotton instead of silk in its manufacture. Gunpowder was known to them a century earlier than before any trace of it appeared in European history. Already in the 11th century they had the compass.

With the rise of the Turkish body-guard under Ma'mun's successor in the 9th century began the gradual decline of the Abbassides, which became more rapid as the Caliphates ended when the Mongols in 1258 captured Bagdad. The changed conditions now under Turkish and now under Persian sway had their natural effect on Arabic literature. Yet it can point none the less to a continuous array of works on poetry, history — in the latter branch Ibn Khaldun (1332–1406) is one of the greatest in Arab annals — philology, anthologies and romances,— which Lane describes in his 'Modern Egyptians'; with fables such as those of Luqman, through the medium of a Syriac version (1299), by Barsuma, a Christian (d. 1316). Luqman is considered by some to be identical with Æsop.

The 19th century witnessed much literary activity in Arabic-speaking lands, not only in Egypt, Syria, Tunis, Algeria and Morocco, but also in cities like Constantinople and Paris, where Oriental writers are accustomed to meet and the learned recognize the wealth and power of the Arabic. Among the more notable writers were Sabbagh (d. 1816), who left a number of works in manuscript in the fields of history and grammar; his friend Boqtor (1784–1821), who left an Arabic-French dictionary; Shaikh Rifa'a, who spent the closing years of his life as head of the Translating Office at Cairo; Faris Al Shidyaq (d. about 1890), who translated the Bible into Arabic and wrote on Arabic synonyms, on animal nature, on his travels, and made various literary and scientific contributions to an Arabic newspaper; Butrus Bistani (1819–83), a Maronite who became a Protestant, wrote on Arabic literature, arithmetic, grammar, etc. Rushaid Dahdah published a number of Arabic texts, chiefly in France. Beyrout was the centre of a literary movement in the 19th century; poems, grammars, dictionaries, biographies were written and the knowledge of the Arabic classic spread, Father Cherkho of the Beyrout University of Saint Joseph being the chief pioneer. History was much cultivated in the Lebanon. Damascus in the seventies and eighties produced many books on law, philosophy, logic, hygiene and theology. Egypt has vied with Syria in its literary activity, the printing presses at Bulaq and private enterprise at Cairo familiarizing the public with Moslem classics, while new writers have done their share in poetry, geography, history. Two historical novels were composed by Zaidan (1834–90), a Syrian Christian. Ali-pacha (1823–93), Minister of Public Instruction, wrote on the metric system (1892) and founded the Cairo Viceregal Library (1870). Habib A. Salmoné of Beyrout and London compiled a great Arabic dictionary and translated Swedenborg's 'Heaven and Hell' into Arabic (1896). In physics, chemistry and natural science there have been numerous authors. The woman question has its expositors and topics of the day are discussed by some writers. To this summary must be added the issue of many newspapers and copious translations from European languages.

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ARABIC, The. A steamship of the White Star line, torpedoed without warning by a German submarine about 60 miles off Fastnet (not far from the scene of the *Lusitania* wreck), on the morning of 19 Aug. 1915, one day out from Liverpool. Bound for New York, the *Arabic* was unarmed and carried 180 passengers (29 Americans) and 243 in crew. She sank in 11 minutes; 44 lives were lost — 19 passengers and 25 of the crew. Two American citizens were drowned, Dr. Edmund F. Woods of Janesville, Wis., and Mrs. Josephine L. Bruguière of New York. The effect of the sinking of the vessel was to aggravate the strained diplomatic relations between the United States government and Germany created by the sinking of the *Lusitania* (q.v.) three months earlier. On 21 July the American government had informed Germany that a repeti-

tion of such "illegal and inhuman acts" as the sinking of the *Lusitania* would be regarded by the United States as "deliberately unfriendly" when American citizens were affected. Nevertheless, the *Arabic* was sunk; none saw the submarine and no attempt had been made to search the vessel or to warn the captain. Five days later (24 August) the German Ambassador in Washington informed the Department of State that the German government trusted that the American government would "not take a definite stand at hearing only the reports of one side, which, in the opinion of the Imperial government, cannot correspond with the facts, but that a chance will be given to Germany to be heard equally." Although the German government "does not doubt the good faith" of the eye-witnesses of the disaster, "it should be borne in mind that these statements are naturally made under excitement which might easily produce wrong impressions." This somewhat naive communication overlooked the central and indisputable fact that the vessel had actually been torpedoed and sunk; it wound up with the declaration that "if Americans should actually have lost their lives, this would naturally be contrary to our intentions"; that the German government "would deeply regret the fact," and tendered "sincerest sympathies to the American government." On 25 August the German Chancellor did "not even know whether the sinking of the ship was caused by a mine or by a torpedo fired from a German submarine," nor did he know whether "the *Arabic* herself may not by her actions, perhaps, have justified the proceedings of the commander of the submarine." On 1 September the German Ambassador wrote Mr. Lansing to the effect that his government had already accepted the American declaration on the submarine warfare before the sinking of the *Arabic,* and he produced the following extract from a proposed reply to the hitherto unanswered American note of 21 July: "Liners will not be sunk by our submarines without warning and without safety of the lives of non-combatants, provided that the liners do not try to escape or offer resistance." Seven days after the wreck of the *Arabic* a dispatch from Berlin announced "on the best authority that the *Arabic* incident may be considered as eliminated as a source of discord between Germany and America; or at least is regarded by the German government in that light." Furthermore, "in its desire to continue its friendly relations with the United States," Germany "had adopted before the sinking of the *Arabic* a policy designed to settle completely the whole submarine problem as affecting America, on the basis of goodwill and mutual understanding." The German report on the *Arabic* case, dated 7 Sept. 1915, was cabled to Washington by Mr. Gerard, American Ambassador in Berlin, on 9 September. It stated that on 19 August a German submarine stopped the English steamer *Dunsley* south of Kinsale and was on the point of sinking her by gunfire after the crew had abandoned the ship. "At this moment the commander (of the submarine) saw a large steamer making directly toward him. This steamer, as developed later, was the *Arabic.* She was recognized as an enemy vessel, as she did not fly any flag and bore no neutral markings. When she approached she altered her original course but then again pointed directly toward the submarine. From this the commander became convinced that the steamer had the intention of attacking and ramming her. In order to anticipate this attack he gave orders for the submarine to dive and fired a torpedo at the steamer. After firing, he convinced himself that the people on board were being rescued in 15 boats." The commander's conclusion, the report continued, was "all the more obvious as he had been fired upon at a great distance in the Irish Sea on 14 August — that is, a few days before — by a large passenger steamer apparently belonging to the British Royal Mail Steam Packet Company, which he had neither attacked nor stopped." While regretting that lives had been lost, the German government was "unable, however, to acknowledge any obligation to grant indemnity in the matter, even if the commander should have been mistaken as to the aggressive intentions of the *Arabic.*" Against this presentation of the case must be placed the statement of Captain Finch of the *Arabic*: "I did not see a single sign of a submarine, and, as far as I am aware, nobody else saw a submarine, either before or after the occurrence." In case a harmonious opinion on the point could not be reached, the German government "would be prepared to submit the difference of opinion, as being a question of international law, to The Hague Tribunal for arbitration. . . ." Having collected all the available evidence of the ship's officers and passengers, the United States government demanded a disavowal of the act and reparation for the American lives lost. While the arbitration proposal was rejected — the principle involving the safety of American lives — the German assurance of 1 September was accepted. On the question as to the amount of indemnity, arbitration would be agreed to. The unalterable determination of the American government led to the desired result, for on 5 Oct. 1915 the German Ambassador in Washington presented to Mr. Lansing the German government's disavowal of the submarine commander's act and expressions of regret for the incident. The Ambassador was also authorized to accept liability for all damages caused to American citizens through the sinking of the *Arabic,* and to negotiate the amounts of the claims. See ANCONA; FALABA; LUSITANIA; ORDUNA; SUSSEX; WILLIAM P. FRYE.

ARABIN, the chief constituent of gum-arabic, obtained by precipitating an acidulated aqueous solution of gum-arabic with alcohol.

ARACAJÚ, ą-rāka-zhoo′, a city of Brazil, capital of the state of Sergipe. It is situated on the Cotindiba River about seven miles from the Atlantic Ocean, lat. 10° 58′ S., and is the port through which passes Sergipe's limited coast-wise and foreign commerce. Products of agricultural industry, especially sugar, rice, cotton and hides, are shipped in vessels of moderate draught, and there is transportation by rail between Aracajú and the interior towns Signão Diaz and Capella. Pop. about 6,000 actual residents of the city, or 30,000 if we include the district, as is customary.

ARA'CEÆ, the designation of an order of endogenous plants having for their inflores-

cence a spadix placed within a spathe. They have neither calyx nor corolla. The leaves are frequently cordate; the fruit succulent, with many seeds. They are acrid in character and often poisonous. The *Caladium sequinum*, or dumb cane of the West Indies and South America, when chewed, causes the tongue to swell so as to cause temporary dumbness. A common English species is the wake-robin. The nearest relatives of the family in America are the Indian turnip, water-arum and skunk's cabbage.

ARACHNIDA, the name applied to the class of arthropods represented by the scorpion, spider and mite. The body is divided into two regions, the cephalothorax and abdomen, the head having been in embryonic life folded back over and fused with the thorax. There are no antennæ, the first pair of appendages resembling mandibles, and called cheliceræ; the second pair end in a large forceps, or chelæ, or in a palpus-shaped appendage called "pedipalpi." The head appendages are not differentiated into antennæ, mandibles, maxillæ and maxillipeds, as in *Crustacea*. There are four pairs of legs ending in a pair of minute claws. On the abdomen there are no appendages. The respiratory organs are spiracles opening into tracheas or air-tubes, or pouches containing numerous leaves or their sacs, resembling the leaves of a book, and hence called "book-lungs." The eyes are simple, never compound, two being situated in the middle of the head, others on each side of it. There may be as many as five pairs of nephridia. The genital outlet is single instead of being double, as in *Limulus*. They have a pair of malpighian tubes or urinary vessels, but, like *Limulus*, possess two large digestive glands, the "liver."

The young are hatched in the form of the adult, there being no metamorphosis except a slight one in the mites. Their embryos have, on at least six abdominal segments, rudiments of limbs, which indicate their descent from animals like *Limulus*. All of the *Arachnida* are terrestrial, none of them living in or near freshwater, except a few mites. Their embryology is like that of *Limulus*, which suggests that the *Arachnida* have descended from the *Merostomata* (q.v.) Whether we take into account the mode of development or the very primitive nature of the appendages, it appears that the *Arachnida* are much less closely allied to insects than was formerly supposed. On the other hand, they differ from the merostomes, and especially their living representative, the king crab (q.v.), in having no gills. Their embryology and morphology tend to show that the class has probably descended from limuloid ancestors, of which there are examples in the Silurian rocks, intermediate between limuloid (*Xiphosura*) and eurypteroid (*Eurypterida*) forms. The characters in which *Arachnida* resemble insects, as respiration by tracheæ and the presence of urinary tubes (which do not occur in *Crustacea* or in any other marine or branchiate arthropods), are probably adaptive and were acquired during a change from a marine to a terrestrial life, and not primitive heirlooms. *Arachnida* also show their later origin than merostomes by the fact that their sexual ducts (oviduct, etc.) are in most cases single, unpaired and in all cases open externally by a common single genital aperture in the median line of the body, at the base of the abdomen. In this respect *Limulus*, with its pair of genital (male and female) openings, situated each at the end of a papilla, which are placed widely apart at the base of the first abdominal legs, is decidedly more archaic. The *Arachnida* are divided into six groups or orders: (1) *Scorpionida* (scorpions); (2) *Pseudoscorpionida* (false- or book-scorpions); (3) *Pedipalpida* (*Phrynus* or scorpion-spiders); (4) *Solpugida* (galeodes); (5) *Phalangida* (harvest men); (6) *Araneida* (spiders); (7) *Acarida* (mites and ticks), the latter comprising the aberrant and degenerate forms, many of them parasitic; while of somewhat doubtful relationship to the *Acarina* are three aberrant groups: the *Linguatulida*, *Pycnogonida*, and *Tardigrada*. See MITE; SCORPION; SPIDERS.

Several of the *Arachnida* are of interest in medicine. A few of the scorpions are poisonous, their sting even causing death, although it is quite certain that there are no poisonous spiders north of Mexico. A number of the mites are found in man. One, the *Demodex canis*, is frequently found in the sebaceous follicles of the skin, notably in comedos, or blackheads. The itch mite (*Sarcoptes scabeii*) bores little canals under the skin, in which it deposits its eggs. The itch is a common disease of Europe, and is becoming more frequent in this country. Sulphur ointment is one of the best parasiticides for this small nuisance.

In the warm countries ticks (*Ixodes*) are troublesome pests. See PARASITES.

ARAGO, ä'ra-gō, **Dominique François**, a celebrated French astronomer: b. in Estagel 1786; d. in Paris, 2 Oct. 1853. After studying at the Polytechnic School at Paris he was appointed secretary of the Bureau des Longitudes, and in 1806 was associated with the Biot and in completing the measurements of Delambre and Mechain to obtain an arc of the meridian which was to serve as the basis of a new metrical system. In 1809 he was elected to fill the seat left vacant by the death of Lalande in the Academy of Sciences, and at the same time he was appointed a professor of the Polytechnic School. In 1811 he communicated to the Institute a paper on a particular modification which the luminous rays experience in their passage through certain transparent bodies, thus paving the way for some of the most brilliant discoveries made in optical science since the days of Newton. In 1812 he began a series of lectures on astronomy, which created an immense sensation. With Gay-Lussac he established in 1816 the 'Annales de Chimie et de Physique.' His discovery of the magnetic properties of substances devoid of iron procured him the Copley medal of the Royal Society of London in 1825, and a further consideration of the same subject led to the equally remarkable discovery of the production of magnetism by electricity. In 1830, on the death of Fourier, Arago succeeded him as perpetual secretary to the Academy of Sciences, becoming in the same year director of the Observatory. After the expulsion of the Bourbons Arago was elected to the Chamber of Deputies as representative of the Pyrénées-Orientales, taking his place on the extreme left, and proving a ready and effective speaker. The revolution of 1848 brought him still more prominently upon the scene, first as Minister of War and Marine in the provisional

government, and then as a member of the executive committee of the National Assembly. His 'Works,' edited by Barral, appeared in 1854–62.

ARAGON, an ancient kingdom in the northern part of the Iberian Peninsula, comprised in the modern Spanish provinces of Huesca, Teruel and Zaragoza. Its area is 18,294 square miles. It is drained by the Ebro and its tributary streams, which traverse a central plain. The northern and southern portions are mountainous and the climate varies according to the elevation above sea-level. It is often very sultry in the plains and valleys while generally cool at higher elevations on the mountain slopes. Wheat, corn and other crops of the cooler climes are grown in the more elevated portions while the olive and vine thrive in the warmer valleys. Copper, lead, salt and sulphur are mined in small quantities in Teruel. Manufactures are in a backward state, coarse linens and woolens being almost the only products. Agriculture is carried on in a primitive fashion; indeed, the burdens imposed on the farmer and agriculturist leave him little incentive to improve his methods or extend production. Trade is hampered with like restrictions. The total population of the region to-day is 971,515. Zaragoza is the chief city, with a population of 112,000. Aragon formed a part of the Roman province of Hispania Tarraconensis, fell to the Visigoths in the 5th century and to the Moors in 711 A.D. A few of the Christian inhabitants fled to the fastnesses of the north where they managed to maintain a degree of independence. This small state was long ruled by Gothic counts, who joined it with Navarre. Ramiro I secured its complete independence in 1035 and it began its 450 years of existence as a kingdom. It was in constant conflict with the Moors and gradually wrested from them important towns and fortresses. By 1118 the kingdom had attained its full territorial growth in the Peninsula, and in 1137 it was joined to Catalonia through the marriage of the respective sovereigns. The new state extended its power to the Balearic Islands, Sardinia, Sicily and Naples, all of which came under its sway before 1340. Barcelona became the commercial rival of Genoa and constant war was waged between them. Aragon was united with Castile in 1479, Ferdinand of Aragon having married Isabella of Castile in 1469. Aragon became definitely merged in the new Spain in 1516 when Charles I ascended the throne. See SPAIN; SICILY.

ARAGONITE, a mineral having the formula $CaCO_3$, and therefore identical with calcite in composition. It is classed as a separate species, however, because it crystallizes in the orthorhombic system. Its specific gravity is also somewhat higher than that of calcite. Occasionally it contains a little strontium, lead, or zinc, and it often occurs in connection with pyrites, galena, or malachite. It is translucent and usually white with a vitreous lustre. In hardness it varies from 3.5 to 4, and it has a specific gravity of about 2.94. Aragonite occurs in fine crystals at Aragon, Spain (whence its name), near Bilin, Bohemia, in Hungary and Sicily, and near Frizington, England. There are no important American localities, though it occurs on stalactitic calcite in caves in New Mexico, Arizona and elsewhere. The coralloidal form, called "flos-ferri," is most beautifully developed in Styria. It is said to be forming rapidly at the present time in the Eureka mine in Nevada.

The minerals aragonite, bromlite, witherite, strontianite and cerussite, all of which are carbonates crystallizing in the orthorhombic system, are classed together as the "aragonite group."

ARAGUA, ą-rä'gwä, one of the states of the republic of Venezuela, including the nine districts of Bruzual, Gisardot, Mariño, Ricaurte, Roscio, San Casimiro, San Sebastián, Urdaneta and Zamora. It is bounded on the north by the Caribbean Sea and Federal District, on the east by the state of Miranda, on the south by Guárico and on the west by Carabobo and Zamora. Its capital is La Victoria, a city of 8,000 inhabitants founded by Francisco Loreto in 1593 in the fertile valley of Aragua. Principal towns are Barbacoas, Ciudad de Cura, Maracay, Ortiz and San Mateo. Chief rivers are the Guarico, Aragua, Tiznados and Chirqua, the first three being affluents of the Orinoco. The last flows into the great Lake of Valencia. The mean annual temperature of the state varies between 74° F. in La Victoria and Maracay and 80° F. in Ciudad de Cura and Ortiz. The industries are chiefly agricultural and pastoral, the products of the former being coffee, sugar, cocoa and cereals. Pop. (1916) 154,000.

ARAI HAKUSEKI, ä'rī, hä'koo-sä-kē, Japanese scholar: b. 1657; d. 1725. He is one of the most noted of the brilliant group of scholars in Yeddo who followed the philosophical doctrines of Chu-Hi. He was a liberal thinker and opposed to the Kogaku school of philosophy. Banned and oppressed his followers instructed young gentlemen throughout the country and so molded public opinion that supreme power was restored to the Mikado in 1868. Hakuseki wrote an autobiography in 1716, one of the first of such works in Japan. He wrote the 'Hankampu' in 1701. It is a history of the Daimios of Japan from 1600 to 1680 in 30 volumes. The 'Tokushi Yoron' is a general history of Japan covering a period of 2,000 years. His 'Seiyo Kibun' gives an account of Europe; it was translated by S. R. Brown and appeared in the 'Transactions' of the North China Branch of the Asiatic Society (London 1827–31). Consult Aston, 'History of Japanese Literature' (New York 1899), and Florenz, 'Geschichte der japanischen Litteratur' (Leipzig 1906).

ARALIA, the designation of a widely distributed genius of about 20 species of dicotyledonous shrubs, trees and perennial herbs typical of the family *Araliaceæ*. The species have large alternate compound deciduous leaves, small umbels of whitish flowers usually arranged in panicles, and two- to five-seeded, variously colored, globular, berry-like drupes. All parts of the plants have a warm, aromatic taste. *A. spinosa,* devil's walking-stick, angelica tree, Hercules' club, toothache tree, a very ornamental shrub or small tree about 12 feet tall (sometimes 40 feet), is common in moist woods and along river banks from Pennsylvania to Indiana and southward to the Gulf of Mexico. Its very stout, prickly stems, large

pinnate leaves and clusters of flowers which appear in midsummer, give a decided subtropical effect upon lawns in the South. It is not hardy in the North. *A racemosa*, spikenard, a widely branched herbaceous species, with large, spicy, aromatic roots and greenish-white flowers which appear in midsummer, is common in rich woods from New Brunswick to Minnesota and southward to the mountains of Georgia. *A. nudicaulis*, wild sarsaparilla, small spikenard, a nearly stemless herbaceous species with a single pinnate leaf a foot high, is common in rocky and sandy places from Newfoundland to Missouri and southward to the mountains of North Carolina. It bears from two to seven umbels of greenish flowers in late spring. The long, horizontal, aromatic roots are believed to be equal to those of sarsaparilla as an alterative and tonic. *A. hispida*, wild elder, bristly sarsaparilla, a bristly stemmed perennial, is found in the same localities and soils as the preceding. It bears several terminal umbels of white flowers in early summer. Among foreign Aralias the Asiatic species are perhaps of most importance. Some, notably *A. cordata*, known as Udo, are of value as human food; others as stock food when grasses are scarce. *A. chinensis*, Chinese angelica tree, is much like its American relative, *A. spinosa*, but is hardier and blossoms somewhat later.

ARAMÆANS, a branch of the Semites, who dwelt in the districts comprised in the Syria of the ancient Greeks, and in Mesopotamia. Their language spread to the neighboring peoples and this fact often renders it difficult to determine the precise limits inhabited by the true Aramaic stock. Their original home is unknown. It is now generally held that the Aramæans moved from northeast Arabia into Syria, Mesopotamia, Assyria, Babylonia and beyond the Tigris about 1500 B.C. They spread the knowledge of the alphabet and exercised a great influence on the advance of civilization. Consult 'Aram' in 'Encyclopædia Biblica' (1899); Meyer, Eduard, 'Die Israelitien' (1906); Schiffer, Sina, 'Die Aramäer' (1911). See SEMITES.

ARAMAIC LANGUAGE. Among the Semitic languages, which are variously grouped as Northern or Assyrian, Central or Aramaic, Western or Canaanite, Southern or Arabic and Ethiopic, according to Wright, or as East Semitic, that is Babylonian and Assyrian, and West Semitic, Aramaic, Canaanite, Arabic, Ethiopic, which is Zimmern's broader and more historical division, the Aramaic has many elements of distinction and covers a long range of centuries. It includes monuments of literature as well as the literature of monuments. While of its original home nothing definite is known, at an early date Aramaic appears in the Old Testament to designate certain districts in Syria ("Aram of Damascus") and in Mesopotamia ("Aram of the Two Rivers"). A number of Aramaisms in the vocabulary of the older Biblical books shows the close relationship between Hebrew and Aramaic, although the latter was considered by the Hebrews a foreign tongue and 100 years before the Babylonian Exile was understood in Jerusalem only by people of culture, a fact proved by the episode in 2 Kings xviii, 26; Isaiah xxxvi, 11. Centuries earlier kinship was illustrated by genealogical tablets and primitive narratives, as for instance, when Kemuel, a son of Nahor, the brother of Abraham, is called "father of Aram" (Gen. xxii, 21). Jacob is termed "A wandering Aramæan" (Deut. xxvi, 5). During the entire period of the Kings, Israel and the Aramæans of the west, whose land was later called Syria and lies north and northeast of Palestine, were in steady intercourse. By a curious fate, Aramaic was to supplant Hebrew, after national decline, as the vernacular and acquire a prominent rank, with the adoption of Aramaized Hebrew forms, as the literary language of the Jews for many centuries in the lands of their dispersion. Before Palestine was Aramaized the language spread gradually and occupied all Syria. It was spoken in the Euphrates toward the east and throughout the districts of the Tigris north and west of the Armenian and Kurdish mountains. "The country of the Aramæans" was the name applied to the province in which the capitals of the Arsacids and the Sassanids were situated. We know, too, that although Assyrian was the language of the government, at a very early date a large body of the people in Babylonia and Assyria were probably Aramæans.

Dialects.—Owing to the rapid spread of the Aramæans, their language received varied development both in grammatical form and idiom as well as in its literary development. Among its chief dialects may be mentioned the Syriac of northern Mesopotamia, in particular the district around Edessa, and it flourished as a literary language from the 2d to the 13th century. Then the Aramaic, as commonly known, includes besides two words in Genesis (xxxi, 47) and a verse in Jeremiah (x, 2), as its oldest remains in the branch passages in Ezra (iv, 8; vii, 8; vii, 12, 26) dating from the end of the 6th or beginning of the 5th century B.C. Next come the portions of the book of Daniel, whose exact date is still a matter of doubt. A much more extensive monument is the Targum literature, which in Onkelos and Jonathan differ little from Biblical Aramaic. To this must be added Talmud and Midrash, which contain much Hebrew as well as Aramaic. The Aramaic portions of both Talmuds (Babylonian, completed at end of 5th century, and Palestinian, completed in beginning of 5th) are of great value. The Aramaic literature of the Jews includes as well certain portions of the Apocrypha, legal decisions of the Geonim, rabbinical authorities in the early centuries of the Diaspora, when Aramaic at first was the vernacular; liturgical selections, the book Zohar, famous in the Cabala, together with a large part of rabbinical literature. Further must be added the dialect of the Samaritans, exemplified in their Targum of the Pentateuch, their liturgy and hymns; Egyptian Aramaic; the Nabatean and Palmyrene of the inscriptions. There is also to be mentioned the dialect retained for some time by the Christians of Palestine as a literary and ecclesiastical language and in which appear Gospel translations and fragments of other works dating from about the 5th century. The language of the Mandæan writings closely resembles that of the Babylonian Talmud. The spread of the Aramaic was effectually checked

in the 7th century by the Arab conquests and it gradually lost its predominance for more than 10 centuries, yielding to a more forceful rival.

Inscriptions.— Some Assyrian weights, which go back to the 7th and 8th century before our era, with some gems and seals of nearly the same age, furnish the oldest data as to the Aramaic alphabet. In the field of inscriptions the material is richer; the most ancient include the colossal statue of the god Hadad, found in 1890 near Zenjirli, in northwest Syria, from the first half of the 8th century B.C. with other writings in that vicinity of a slightly later date, and two inscriptions found in 1891 at Nerab, near Aleppo, alleged by Cl. Ganneau to belong to the 6th century B.C. Some Aramaic inscriptions have been found in Egypt, of the Persian period, one bearing the date of the year of Xerxes, 482 B.C. A few ancient Aramaic inscriptions have been found in Arabia, at Tema, probably from the 5th century B.C. Within recent decades valuable data have come to light from the 4th century, bearing upon Jewish military colonists and others who came to Egypt — the Judaco-Aramaic papyri are likely to be supplemented in time. Of special interest by reason of their number and contents are the Palmyrene inscriptions, votive, honorary, sepulchral, etc., which began shortly before the Christian era, and extend to about the middle of the 3d century, as well as the Nabatean, whose kingdom was centred at Petra, in northern Arabia, and who were Arabs, but used Aramaic for writing and commerce. It was finally absorbed by Rome in 106 A.D. To this class belong the Sinaitic inscriptions, written in Nabatean dialect and script and dating from the first four centuries A.D. They were found along trade routes in out-of-the-way valleys. Their number can be gathered from the fact that Euting has recorded 677 in his standard collection (1891). This fact would indicate the extent of Aramaic influence.

Characteristics.— Nöldeke denies any poverty in Aramaic, as has been asserted, and claims that, despite its larger borrowings from foreign languages, the proportion of really foreign words in older Aramaic writings is smaller than the proportion of Romance words in German or Dutch. With its special treatment of dentals, it is poorer in vowels than Hebrew. It is rich, however, in conjunctions and adverbs, thus enabling it to express slight changes in meaning, and permits much freedom in the order of words, becoming rather diffuse as well in its use of additional pronouns. One peculiarity may be mentioned; in the western dialect the prefix of the third person of the imperfect is *y odh;* in Syriac, with changes in other of the eastern dialects, it is *nun.*

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ARAN ISLANDS, or **SOUTH ARAN,** Ireland, three islands situated on the west coast at the entrance of Galway Bay, to which they form a natural breakwater. They lie in a southeasterly direction. Beginning with the northernmost they are called respectively Inishmore or Great Island; Inishmaan or Middle Island; and Inishiar or Eastern Island. The highest elevation is 354 feet. The islands are formed of carboniferous limestone, and the soil is very sandy, affording scant pasturage and yields little to cultivation. The total area of the islands is about 11,500 acres. The inhabitants are perhaps the most primitive people of Europe in their mode of life and thought. Gaelic is the common tongue, although English is understood fairly well on Inishmore. Here may still be seen a curious intermingling of Christian and Druidic worship. The main industries are fishing and kelp-burning. There is steamer communication with Galway, 30 miles distant. The population in 1911 was 2,679. These islands are remarkable for a number of architectural remains of early date. On Inishmore, on a cliff 220 feet high, stand the remains of a circular cyclopean fortress called Dun Aengus; its *chevaux de frise* is still to be seen. It is ascribed to the 1st century of our era. Inishmore is often called *Ara na Naomh,* Aran-of-the-Saints, from the numbers of religious recluses who dwelt here soon after the introduction of Christianity in the 5th century. Here too are the remains of the abbey of Saint Enda, the patron of the islands. The chief town is Kilronan, on Inishmore, with a population of 460. In recent years the islands have been the hunting ground for philologists, linguists, artists, etc., who find here open chapters in the history of the race which have been long since closed elsewhere. The islands were a favorite resort of the late John Millington Synge, the Irish playwright, who made them the scene of his drama 'Riders to the Sea,' and has recorded his impressions of the islands and their inhabitants in 'The Aran Islands' (Dublin 1903).

ARANSAS, ą-răn'zăs, **BAY,** an inlet on the coast of Texas, connected with the Gulf of Mexico by a channel known as Aransas Pass. A bar at its mouth renders its harbor of very little commercial importance, in spite of the money lavished in various attempts to establish there a harbor and port of entry. During the Civil War it was the scene of a conflict between the Confederate and Federal troops.

ARANSAS PASS. See ARANSAS BAY.

ARANY, ô'rôný, **Janos,** Hungarian poet: b. Nagy-Szalonta, 1 March 1817; d. Pesth, 22 Oct. 1882. He was of humble parentage; his parents were very poor, but they made every effort to give him an education. At 15 he entered the college of Debreczin, where he distinguished himself. He was attracted to the stage, joined a company of strolling players, but soon returned discouraged to his father's house. He became a notary and lived in retirement for several years. In 1845 he published the satirical epic 'Az elveszett alkotmány,' which won a prize for the most humorous poem offered by the Kisfaludy Society of Pesth. Two years later he was awarded a second prize for the first part of 'Toldi,' his great trilogy founded upon Magyar traditions. This work brought him a widespread popularity both among the learned and among the

lowest ranks of the people, who recognized his gift of weaving their traditional legends and his appeal to the spirit of national pride so characteristic of the Magyar peoples. In 1860 he became director and afterward secretary of the Kisfaludy Society, and in 1870 he was appointed general secretary of the Hungarian Academy of Science. His more noteworthy works are 'Murány ostroma'; 'King Buda's Death,' an epic in 12 cantos; 'Toldi's Love' and 'Toldi's Evening,' the second and third parts of the Toldi trilogy. Arany is regarded as, next to Petöfi, the greatest of modern Hungarian poets; the one who raised Hungarian poetry to its greatest height. His work is noted for its artistic finish and its happy combination of the spirit of old Magyar folklore with the classic polish of a master. His works have been translated several times into German, among others, by Kertbeny (Leipzig 1851); Kórodi, L., (Kronstadt 1863); Dux (Pesth 1861); and Sponer (Leipzig 1880).

ARARAT, or **PILOT MOUNTAIN,** an American mountain about 3,000 feet in height, in Surrey County, N. C. It is situated between the Ararat and Dan rivers and is visible for a long distance.

ARAS, ą-räs, a river of Armenia, rising in the Turkish pashalic of Erzerum. After flowing for some miles through Turkish territory to the new Russian frontier, it turns eastward to the Ervian plain north of Ararat, whence it sweeps in a semi-circle mostly between the Russian and Persian territories to its confluence with the Kur, 60 miles from its mouth in the Caspian Sea. Its entire course is about 500 miles. Modern research has discovered that it originally flowed directly into the Caspian Sea, as ancient writers had claimed. It is identical with the ancient Araxes.

ARAUCANA, ă'rou-kă'nę-ą, **LA,** the famous "epopeya," as it is called by Chilean scholars, written by D. Alonso de Ercilla y Zúñiga. It describes, in 37 cantos, the conquest of Chile, and takes rank as the finest heroic poem in the Spanish language. Further, as Señor Medina writes in his preface to the recent edition (Santiago de Chile 1910), of which he is both editor and publisher, Chile's good fortune, unique in modern times, is most remarkable in this respect, that its *origines* (he might have added aborigines) have been immortalized by the most notable epopeya of Castilian literature. Ercilla, who was born in Madrid, 7 Aug. 1533, came to the New World in his 21st year, and, as a soldier, shared the adventurous life of the Spanish conquerors or their successors in South America's far south for eight years, more or less. After returning to Spain (in 1562) he completed the 'Araucana,' the composition of which he had begun in Chile. We shall not at present discuss the editions; it is enough in this brief note to say that the edition of Madrid (1589–90) was in its day truly definitive, inasmuch as it was undoubtedly printed under the immediate inspection of the poet — the last edition, indeed, to receive his personal attention. It is known that Ercilla died at Madrid; the date is given conjecturally as 29 Nov. 1595. See CHILE.

ARAUCANIANS, ă'row-kă'nė-ąns, a South American native race in the southern part of Chile, formerly occupying Chile, Argentina, Chiloe and the Chonos Archipelago, etc. When first encountered by the Spaniards in 1535 they were a confederacy of the loosest kind, with many tribes and sub-tribes in entire independence, and in about the same political stage as the North American Indians, electing a *toqui* or war-chief and deposing him at will, with no authoritative head in peace, practising polygamy. and for worship conciliating an evil spirit, Quecubu,— probably the same as the Fuegian spirit immortalized by Shakespeare as "Setebos," the shape given it by Magellan's sailors. They were divided into Picun-che or North-men, living north of the river Maule; Pehuen-che or Pine-men, occupying through central Chile and the pine forests on the western slopes of the Andes (the chief division of the tribe, and from whom most of the modern Araucanians are descended); Huilli-che or South-men, occupying the rest of the Chilean mainland; Puel-che or East-men; South-men or Patagonians; Chono; Lubu-che or Water-men; Cuncho; Payo, etc. But their instant and indomitable cohesion in face of the Spanish attack shows that they were of much higher political stamp than the North Americans. No other native race in the western hemisphere retained its independence anything like as long. For over two centuries they waged warfare with the Spaniards, broken only by truces sought by the latter, though their numbers were small compared with Aztecs or Quichuas, who went down at a blow. Ercilla's famous epic 'Auracana' (q.v.) commemorates their early heroism and that of their powerful chief, Caupolican. In 1641 Spain conceded their independence, confirming it in 1655, imposing only the condition that no enemies of Spain should be allowed to enter their country; an easy condition, as it amounted only to keeping out all foreigners, which they were glad to do. The territory left them was about 30,000 square miles, from the Andes to the sea, and from Arauco Bay to the river Calle-Calle. The war was renewed nevertheless, and went on a century and a third longer; till in 1773 the natives, weakened by war and social practices, were compelled to submit. They had not lost the memory of their past, however, and in 1861 a French adventurer named Antoine Tounens, originally a provincial lawyer, had himself elected king of Araucania as Orélie Antoine I; but the Chilean government conquered and deposed him and sent him back to France. In 1870 the Araucanians recognized the sovereignty of Chile. Araucania occupies a great part of the province of Arauco in south Chile, and is divided into four parallel north-and-south districts, each formerly governed by a *toqui* whose rule had become hereditary before its extinction. The inhabitants are now a mixed race with much Spanish blood. They number perhaps about 50,000, but are said to be decreasing, owing to smallpox, dysentery, liquors and polygamy. They are of a pale yellow color, and in character and life resemble the higher North American plains Indians, such as the Navajos. They are uncivilizable and unchristianized; nomad herdsmen of horses, cattle and sheep; despising agriculture, eating little but meat, and living in skin tents; but skillful woolweavers, skin-dressers and weapon-makers. Their language is so harmonious and flexible

that an enthusiastic missionary student once attempted to introduce it into Europe to supersede Latin. Their stock in Chiloe are called Chilotes.

ARAUCARIALES, a greater group of coniferous trees, once of cosmopolitan distribution, but now restricted to two genera, *Araucaria* and *Dammara,* both of the southern hemisphere. The name is derived from Araucania or Arauco, the district of southern Chile where the superb form *Araucaria imbricata* of the Nahuel Bute mountains and upper Biobio valley was early observed (1786). The seeds of large size formed an important food of the indigenous Araucanian Indians.

Araucaria imbricata, the Chile pine, Pehuen or "monkey puzzle" is the hardiest forest-maker of its order. The Andine forest occupies the higher volcanic ridges and crests along both flanks from lat. 37° 30′ to 40° S. with a width of little more than 100 kilometres, between the altitudes of 600 and 2,000 metres. On the Chilean side there is a heavy snowfall. According to altitude, and to exposure which is greater in the Argentine extension, the trees vary much in size; but they may grow straight as a granite column to an extreme height of 45 metres and diameter of two or more metres. Both stem and branches of the young trees are closely beset by the imbricating spirals of broadly spinose leaves, as persistent as those of cycads. The stem tends to retain a nearly constant diameter throughout its length as the irregular whorls of lesser lateral branches are constantly shed and overgrown. Only a thick-set crown finally surmounts the heavy columnar trunk. After excision of the leaves the outer bark slowly divides into irregularly polygonal deeply-pitted plates. The appearance of the trees is singular, that of the pure stand forests remarkable. Like most other members of the Araucariales these trees are characteristically diœcious. The staminate cones are larger than in any of the Coniferales, having the size seen in some of the cycads. They are oval, 10 or more centimetres long, by 5 centimetres thick, and borne terminally in groups of four or five in the lateral branches. Ovulate cones are terminal on the lateral branches and may reach a length of 16 centimetres with a diameter of 20. There is a more gradual transition from foliage to fertile leaves than in any other existing gymnosperm. The megasporophyll bears a single large dicotyle-donous seed four or more centimetres long. The wood is rather hard, smooth and durable; but the forests, owing to their isolated position, retain nearly their primæval facies. In Chile lofty hardwood forests with a dense undergrowth of bamboo give way to the Araucarias. These then extend to the tree line as a more and more open forest. As seen about Llaima and other volcanoes of the Biobio, the sharp transition to grassy slopes, often ending in more or less permanent snow fields, produces a rarely picturesque effect. Rather the purest stands occur on the Argentine side of the Andes in the lake region between lat. 38° and 40° S. Lago Aluminé and other lakes where the trees are abundant have their North American counterparts in the Cascade Mountains south of the heavier coniferous forests and next the dry interior Washington basin. Lake Chelan is one of these physiographic equivalents with like climate and soil. Trees a half metre in diameter with an age of possibly 100 years prove the successful introduction into California.

Araucaria brasiliana, the Brazil pine, a closely related more sub-tropical species, is a culminant forest constituent of the uplands of southern Brazil, mainly between 25° and 30°. Especially in the state of Santa Catarina, to the south of the Iguassu River, this tree dominates a remarkable stratified columnar facies. There the open forest is about equally made up of tree ferns three to five metres in height, slender-stemmed palms 10 metres high and the over-topping pines 20 to 30 metres in height. Some outliers of this imposing forest occur further north in the state of Minas Geraes. At Cobijan in the mountains of south-eastern Bolivia (lat. 21° S.) there is also a small area of *A. brasiliana* or a closely related form (*A. saviana*).

Other species with large leaves are *Araucaria Bidwilli,* the Bunya Bunya of Queensland, and *A. Hunsteinii* of Kaiser Wilhelm's Land. The remainder of the Australo-Malayan species are small and narrow-leafed, but lofty forms. They centre in New Caledonia with *A. Cooki, A. Balansæ, A. montana, A. Muelleri* and *A. Rulei.* The two latter have staminate cones of unusual length (24 to 25 centimetres). The majestic *Araucaria excelsa,* or Norfolk Island pine, was discovered by Captain Cook, who says that on nearing Norfolk Island the stems were taken for basaltic columns! This species attains a height of over 200 feet. The cone scales are winged with a hooked apex. The half-hardy young plants are widely grown in conservatories. *Araucaria Cunninghamii,* the Moreton Bay pine, is the most widely spread of the Australian species, extending to Cape York and New Guinea.

The genus *Dammara* (dăm′-à-rà) is continental only in Queensland (*D. robusta, D. Palmerstoni*) and the Malay Peninsula (*D. loranthifolia*). It is essentially a Malaysian island type. *D. obtusa* occurs in New Hebrides, *D. Moorei* is New Caledonian and *D. Vitiensis* Fijian. *D. macrophylla,* with the largest leaves of all (17 centimetres long by five broad), is a native of the Queen Charlotte Islands. One of the best-known species is the Amboyna pitch pine, *D. orientalis,* found also in Java, Sumatra, Borneo and other eastern islands. The highly aromatic gum of this tree, called by Amboyna islanders "Dammar puti," gives its name to the genus. The Kauri pine (or *Kowrie*), *Dammara australis* of New Zealand, abundant in the North Island between the North Cape and lat. 38° S., is perhaps the most striking species. The finest forest tree of New Zealand, it often reaches a height of 30 metres and thickness of three metres. But columnar forms with bushy heads may reach 50 metres high by five to seven metres in diameter. Darwin says ('Voyage of the Beagle'), "The crown of branches at the summit is out of all proportion small to the trunk; and the leaves are likewise small compared with the branches." The bark is thick and resiniferous. As in the other Dammaran forms the leaves are narrow-based with a broad lamina and much like those of cycads; they are

four to five centimetres long by one centimetre broad, thick, leathery and persistive. The seed cones are spherical and five to eight centimetres in diameter, or much smaller than in *Araucaria*. The rich brown amber yellow Kauri gum or resin is abundant in the sites

strength, durability and easy working; lumbering and destructive fires are fast limiting the forests.

Fossil Record.— The geological history of the Araucariales is long. Owing to the resemblance of the wood to that of Cordaitaleans

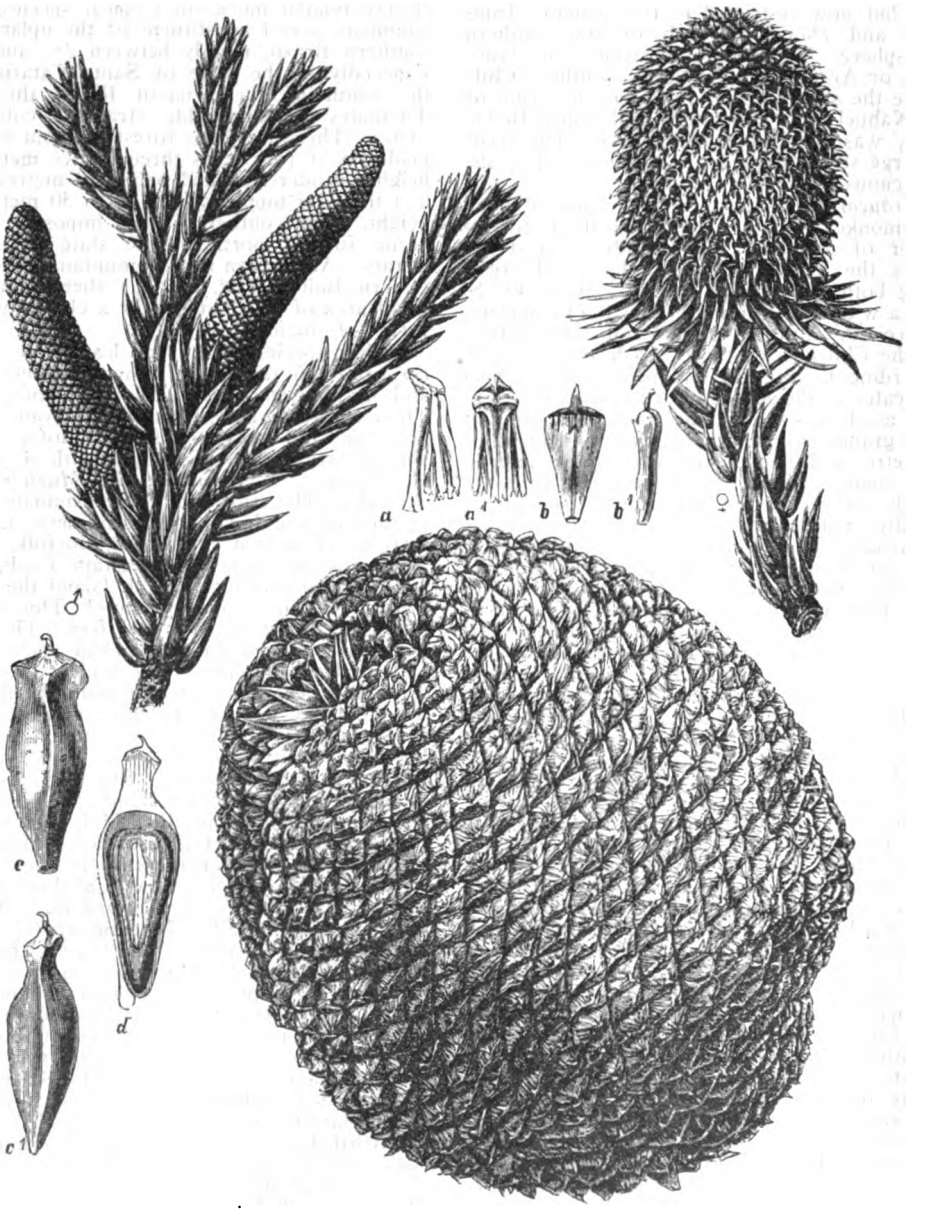

FIG. 3.— *Araucaria Braziliana*. Left above, staminate, right above, young ovulate cones. Right below, mature ovulate cone. *a a'* and *b b'*, side and front views respectively of micro- and megasporophyll; *c c'*, cone scale; *d*, cone scale showing seed. All figures about half size, except *a a'*, which is enlarged.

of previous forests in lumps reaching the size of the largest Araucarian cones. The properties are similar to that of the "cat's eye" or Dammar of *D. orientalis*. This gum oozes from the tree in large quantities in a soft, viscous state. The timber is notable for

it is difficult to prove which of the so-called *Araucarioxylon* types, so abundant in the Palæozoic, are directly related to the modern forms; but from the Rhætic on, the presence of Araucariales closely related to those of today is well attested. Hollick and Jeffrey de-

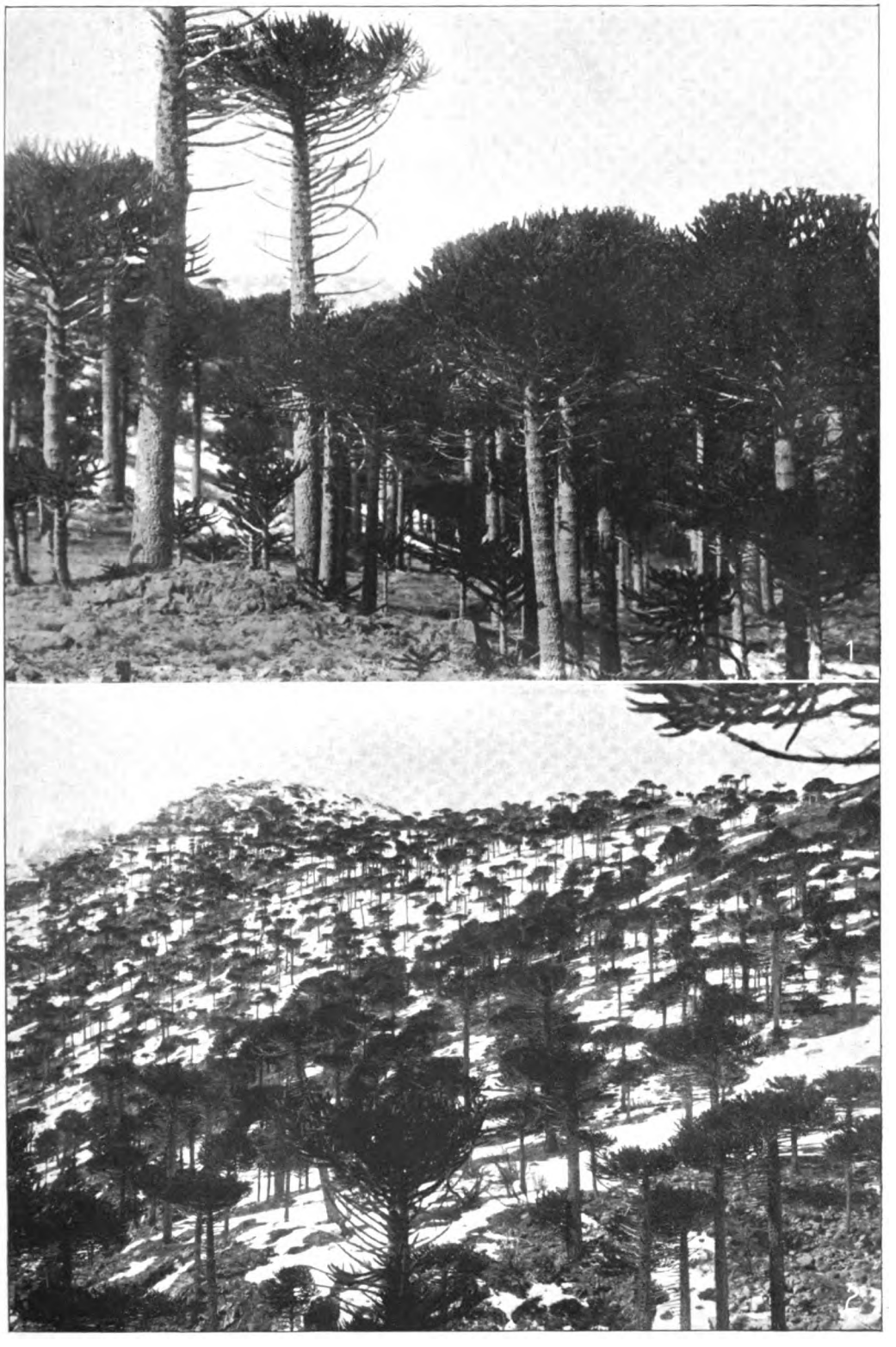

Fig. 1 — *Araucaria imbricata*, pure stand forest of the Chalil, Argentina. (Observe the young plants, some springing from roots)

Fig. 2 — *Araucaria imbricata*, pure stand forest of the Chalil, Argentina, at upper limit of two thousand meters or over

scribe various forms from the Cretaceous of Staten and Long Island. A fine cone called *Araucaria hespera* occurs with the horned dinosaurs of the Laramie, also a branch (*A. Hatcheri*) closely related to the Brazil pine. Araucarian types had a wide distribution in the climax forests of both the northern and southern hemispheres during all of the Jurassic, and appear to culminate in the Cretaceous. Toward the close of the Cretaceous they ceased to play a greater rôle as forest dominants and began a retreat or restriction which lasted throughout Tertiary time, and ended in the scant distribution outlined above. Geologically speaking the Araucariales are very slowly moving toward extinction.

Relationships.— The origin of the Araucariales, and their relationships to other gymnospermous groups, are uncertain. Neither systematists nor morphologists are here in accord. Every possible hypothesis of descent has been suggested. It is urged (1) that the Araucariales sprang from Cycadofilicaleans direct, (2) that they are of Cordaitean origin, (3) that they are Lycopodiaceous derivatives, (4) that the Abietineæ are the oldest conifers and Araucarians a modern offshoot from them. (I) The possibility of Cycadofilicalean origin is much strengthened by recent investigations of the Cycadeoids. It is now seen that *Araucaria* has much in common with both Cycads and Cycadeoids: the robust armored stem is analogous to that of the Cycadeoids, this being true of structure, cortical development and both the major and minor branching; the roots freely send up young plants, and seedlings are stout and tenacious of life; the renewed growth of the reproductive shoot from a lateral bud is cycadaceous and cycadeoid; the large pith and thin, woody cylinder of the shoots, vegetative and reproductive, and the complete transition from foliage to fertile scales of the large cones are also cycad-like; while the megasporophyll with its small ligule finds a counterpart in the decurved microsporophyll of the Cycadeoids. Finally the presence of a leaf gap opposite the outgoing foliar trace, not only in the cone, but in stem and seedling, is also a Pteropsid feature and not lycopodiaceous. (II) Relationship to the Cordaitales is found in the retention of pitting of the tracheids in different regions of the plant recognized as primitive. Especially in the cone the pitting may be as much as five-seriate, with the pits alternate, hexagonal and extending from end to end of the tracheid. As in Cordaiteans, too, the medullary ray cells are thin-walled and less specialized than in the pines. The resin tissue of the secondary wood consists simply in resinous tracheids associated with the medullary rays, and of parenchyma derived from tracheary tissue. Stem and leaf morphology, as well as habitus, suggest Cordaitean affinity. (III) In defense of a lycopodiaceous derivation it is pointed out that *Cheirostrobus* serves to bridge the gap between the male sporophylls of *Araucaria* and the Lycopods; that *Lepidocarpon*, which is outwardly a seed, is the link between the Araucarian seed and the Lycopod sporangium; that lycopodiaceous wood with its scalariform pitting does not fundamentally differ from Araucarian wood; that transitions between the pitted and scalariform sculpturing of the radial tracheidal wall occur in various plants recent and extinct. (IV) The theory of an Abietinean ancestry depends on certain traumatic "revivals," and on the Cretaceous occurrence of Abietineans (*Prepinus*) with leaf bundles possessing centripetal wood like those of *Cordaites*. Even more than the preceding views of relationship and descent, this latter theory requires rigid examination in the light of the fossil record and all the evidence it may be made to yield. It has been suggested that all the forms discussed have been discrete since Palæozoic time.

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ARAUCO, ą-ro'kō, a province of Chile with an area of 2,457 square miles. It is bounded by the provinces of Concepción, Biobio, Malleco and Cautin, forming but a strip along the Pacific coast. The inhabitants number about 62,500 or 63,000 (1916). The capital is Lebu, with population of 3,500.

ARAUJO DE AZEVEDO, ą-row'zhō dā ä-zą-vā'do, Portugese statesman: b. Sa, 1754; d. Rio de Janeiro, 1817. In 1789 he became Ambassador at The Hague and in 1797 negotiated a treaty in Paris which the Directory refused to ratify. Soon afterward he was appointed Ambassador in Berlin and later to a similar post at Saint Petersburg. He became Minister of Foreign Affairs in 1803, but on the capture of Lisbon by Napoleon in 1807 accompanied the King to Brazil. At Rio de Janeiro he founded schools of fine arts and medicine, introduced the tea culture into Brazil and was an active patron of agriculture and other industries. In 1815 he was created Count of Barca. His literary pretensions were not inconsiderable. He wrote two tragedies, and translations from Horace, Gray and Dryden.

ARAUJO PORTO-ALEGRE, ą-row'zhō pôr'tō-ą-lā'grā, **Manoel de,** Brazilian poet and architect: b. Rio Pardo, 1806; d. 1879. He studied art at Rio de Janeiro and studied architecture and art in Paris and Italy and became professor at the Academy of Art in Rio de Janeiro. In 1859 he was appointe Consul-General at Stettin. He not only designed several important buildings in Rio de Janeiro, but was the author of several comedies, of 'Colombo,' an epic, and 'Brasilianas,' a collection of poems (1863).

ARAUNA, ä'ra-oo'ną, the name of a South American tribe of Tacanan stock, whose

home is on the borders of Peru and Bolivia, regarding whose appearance and customs travelers differ widely. According to some accounts they are naked and ill-formed cannibals, while according to others they are light-colored, mild-mannered agriculturists. Another account states that they have temples with idols of wood and stone and exclude women from all religious rites. See TACANA.

ARAURE, ą-row'rā, Venezuela, a town in the state of Lara, 20 miles south of Barquisimeto, the centre of a fertile region producing coffee, cotton and cattle. The battle of Araure took place near here, 4 Dec. 1813. Pop. 4,000.

ARAVULLI, ăr'ą-vul'le or **ARAVALLI**, a mountain range in Hindustan about 300 miles in length and a width varying from 10 to 60 miles from lat. 22° 40′ N. to lat. 26° 50′ N. Its river system is extensive, but the valleys enclosed within the range are mainly sterile. The vegetation is poor.

ARAWAKAN, ä-ra-wä'kan, **STOCK** (from the Arawaks, q.v.), the most widely diffused linguistic stock of South America, and originally forming a curious and significant link between the South and North American regional if not philological stocks. Their habitat reached from Bolivia and southern Brazil not only to the northern coast of Venezuela, but — while barred to the westward by the Colombian Chibchas or Muycas of the Magdalena basin — occupied the entire West Indies and had an outlier of several villages in Florida. Just before Columbus' discovery, however, they had been expelled from the southern Antilles and part of the adjoining South American coast by the fierce Caribs (q.v.) from the lower Orinoco, who had seized their women for wives, most of the latter still speaking Arawak when the Spaniards found them. The larger Antilles were still Arawak, and the names given in the early West India voyages are intelligible in this set of languages yet. The Arawakans have neither the energy and cohesiveness of the Araucans, the splendid physique and fiery vigor of the Caribs, nor the political development of the Quichuas in the past; they are below the medium stature, and of no great stamina. Yet they had, perhaps owing to this very lack of savage vigor, an intellectual and artistic development and a stage of culture above the surrounding tribes: they made fictile vases decorated with grotesques of men and animals, were skilled artisans in stone, gold and wood and excellent weavers; and the island Arawakans cultivated not only corn and manioc for food, but cotton and tobacco, whose use the Europeans took from them. There are probably a hundred or more different tribes of this stock scattered through Brazil, Bolivia, the Guianas, Venezuela and Colombia. Among the chief, besides those mentioned below under Arawaks, are the Manaos near that city, at the junction of the Amazon and Negro; the Waupes, Maipures and Miranhas, in the extreme west of Brazil next to Colombia, on the llamos between the Negro and Amazon; the Goajiros on that peninsula west of the Gulf of Venezuela; the Piaroas on the Orinoco near its junction with the Meta; the Maneteneris in the northwest angle of Bolivia; the Baures and the Moxos or Mojos in northeast Bolivia, next Matto Grosso; and the Antas in extreme south Brazil, near Uruguay. Beuchat and Rivet within recent years have in their studies sought to extend the original territory occupied by the Arawakan stock. Consult recent works of Beuchat and Rivet, Chamberlain, Koch-Grünberg, Schmidt, especially Koch-Grünberg's 'Die Aruak-Sprachen Nordwestbrasiliens' (Vienna 1911).

ARAWAKS, ā'ra-wāks (name most improbably defined "meal-eaters" — that is, of cassava bread — from a Tupi word: not more descriptive of them now than the Tupis or any other South American race except the Araucanians, and they hunt and fish as well as raise corn and manioc. Their own name is Lokono or Lukkunnu, "men": cf. the names Illinois, Innuit, Alemanni, etc.), a tribe of South American Indians living on the coast of British and Dutch Guiana, across the Corentyne and Berbice rivers, and taken as the type of the great Arawakan stock (above). They are not pure-blooded, however, being mixed with Caribs, etc., in a conglomerate of plantation laborers. The term is also used in a broader sense to include all the tribes of this stock in British Guiana and the neighboring corner of Brazil, with the extension noted into Dutch Guiana: Tarumas and Atoradis of the upper Essequibo basin, Wapisianas of the upper Rio Branco in Brazil, etc., as well as Arawaks proper. All these are in a very primitive stage of culture, making marriages by abduction after orgies on corn spirits, counting descent through females, having the clan system, and practising the couvade (q.v.). The Atoradis are almost white, or not duskier than South Europeans, with fine figures, especially the women having much beauty and dignity of appearance. The Wapisianas are browner and less graceful, but their language is so soft, sonorous and vocalic that it is the general medium of communication for trade and other intercourses among all the tribes in this region, even the Caribs; and the Atoradis have nearly abandoned their own for it.

ARAXES. See ARAS.

ARAYAT, ą-rī'ąt, Philippines, town on the island of Luzon, province of Pampanga, 12 miles north of Bacolor, occupied by the American army under General Young 12 Oct. 1899. Nearby is an extinct volcanic cone, 3,564 feet high. Pop. 12,904.

ARBACES, a Median general under Sardanapalus and the founder of the Median empire in 876 B.C. The dynasty founded by Arbaces lasted till its overthrow by Cyrus, 559 B.C.

ARBALEST. See CROSS-BOW.

ARBELA, now **ARBEEL**, a small town in Asiatic Turkey which gave its name to a decisive battle fought by Alexander the Great against Darius at Gaugamela, about 20 miles distant from it, 1 Oct. 331 B.C. There are several large mosques in the modern town. Pop. about 6,000.

ARBER, Edward, English scholar: b. 1836; d. London, 23 Nov. 1912. He was professor of English literature at the University of Birmingham, 1881–94. Mainly self-educated, he became a clerk in the Admiralty, studied English literature in his spare time and undertook the editing and republication of many English books and tracts of the 16th and 17th

centuries, beginning in 1868 with Milton's 'Areopagitica.' He was knocked down and killed in the street by a taxicab. His best-known editions are 'English Reprints' (1868–80); 'Tyndale's New Testament of 1525' (1871); 'A Transcript of the Registers of the Company of the Stationers at London' (1875–94); 'An English Garner' (1877–96); 'An English Scholar's Library' (1878–84); 'The First Three English Books on America' (1885); 'The Story of the Pilgrim Fathers, 1606–23' (1897) 'British Anthologies' (1899–1901); 'The Term Catalogues' (1904–06).

ARBITRATION, History of in the United States. See UNITED STATES — ARBITRATION.

ARBITRATION, Industrial. This is the process by which an authoritative decision is obtained in the case of a controversy arising between one or more employers and a group of employees, or between two or more groups of employees, when such controversy cannot be settled by direct negotiations between the parties concerned. In such cases it is customary to refer the questions at issue to one or more persons, called "arbitrators," who are appointed to investigate the facts and to render a "decision" or "award." Conciliation and mediation are less formal methods of settling industrial disputes, and consist merely of endeavors on the part of some person or group of persons, not a party to the dispute, to promote amicable negotiations between the disputants, which may lead, either to an immediate settlement, or to an agreement to submit the matter in question to arbitration.

Statutory provision for the formation of permanent official or semi-official boards of arbitration is made in many countries and smaller political subdivisions. In some instances the submission of matters in controversy is compulsory, but more often it is provided that upon application of one or both of the parties the board shall provide for the holding of hearings, at which testimony is taken, and following which the board shall render an award. Where arbitration is voluntary, it is customary for both parties to enter into a formal agreement to abide by the decision of the arbitrators.

In the settlement of controversies with reference to wages, hours of labor and general conditions of employment, voluntary arbitration has proved very effective, and in many instances disastrous strikes and lockouts have been averted or brought to an end by this means; but where questions of principle or general policy, such as recognition of the union, exclusive employment of union labor, use of union label, etc., are involved, the parties frequently decline to voluntarily submit the question at issue to arbitration, when, therefore, it becomes necessary for public authorities in the interest of public welfare to insist that the matter be so submitted. Such compulsory arbitration may be limited merely to the reference of the dispute to arbitrators for investigation, during which period hostilities shall be suspended, as in Canada; or, in addition to such reference, the arbitrators may be empowered to compel the attendance of witnesses and the production of papers, as in Germany; or it may be even further provided, as in New Zealand and other Australian states, that the disputants shall be compelled by law to abide by the decision of the arbitrators, under specific penalty for non-observance of the terms of the award.

In the following paragraphs several important systems of industrial arbitration provided for by law are briefly described. Purely unofficial boards of arbitrators, most of which are formed merely in connection with a single controversy, are not, because of the great variety of such boards, included within the scope of this article.

France.— The first definite provision for the settlement of industrial disputes appears to have been the tribunal established before the French Revolution at Lyons, France, for the settlement of disputes in the silk industry. Although this tribunal was abolished with the trade guilds in 1791, it had proved so effective that, in 1806, Napoleon created the councils of experts (*Conseils des Prud'hommes*) having quite similar functions. The councils, at first established in only a few cities, are now found in all of the important industrial centres in France, and similar councils have been established in other countries. For many years these councils considered only controversies between employers and individual employees, and it was not until the passage of the Conciliation and Arbitration Act in 1892 that provision was made for the settlement of collective disputes, that is, disputes between one or more employers and a group of employees. To the extent that application has been made for the settlement of industrial disputes under the provisions of this act, its operation has been fairly successful; but unfortunately only minor matters are thus referred for settlement, and it does not appear that the act has, to any great extent, served to prevent strikes and lockouts, which during very recent years have been both numerous and important.

Germany.— Industrial courts having jurisdiction in the manufacturing industries (*Gewerbegerichte*) had been established in various localities in Germany since the first quarter of the 19th century, and previous to 1869 three states — Prussia, Saxony and Saxe-Weimar — had passed laws providing for the establishment of such courts. By a provision of the industrial code of 1869 local authorities were authorized to establish such courts, provided employers and employees were equally represented thereon. In 1890 an imperial act was passed establishing uniform regulations governing the form and procedure of the local courts and extending their functions so as to provide for the arbitration of collective disputes. An act passed in 1901 amended in certain important particulars the act of 1890, especially with reference to the settlement of collective disputes, which prior to that date had not been arbitrated with any large measure of success. The act of 1901 authorized the courts to act on their own initiative without waiting for either party to the dispute to make application for its services, and provided that the arbitrators should be appointed by the parties concerned in the controversy. The appearance of the parties to the dispute was made compulsory and a penalty was provided for non-attendance. When both parties ask for

arbitration the court then ceases to be a board of conciliation and becomes a board of arbitration; and if only one party makes application it is the president's duty to urge arbitration upon the other party. Decisions in cases of arbitrations are rendered by a majority of the arbitrators, but the president may abstain from voting in case of tie. The acceptance of the decision is not compulsory except when both parties have previously agreed to abide by the award. The act of 1901 further provided for the compulsory establishment of industrial courts in all cities having a population of over 20,000, and they may be formed elsewhere at the option of the state or upon joint application of employers and wage earners. In 1904 mercantile courts (*Kaufmannsgerichte*) for the settlement of disputes between merchants and their employees were established. Although the records for recent years show that there has been a growing disposition to refer industrial disputes to the courts, nevertheless the number of disputes thus referred has constituted only a very small percentage of the total number arising.

Great Britain.— Several important acts with reference to the settlement of industrial disputes by conciliation or arbitration were passed in Great Britain during the 19th century, among which may be mentioned the Consolidation Act of 1824, the Conciliation Act of 1867, the Arbitration (Masters and Workmen) Act of 1872 and the Conciliation Act of 1896. Of these four acts, the last named may well be described briefly in this connection. This act provides for the registration of private conciliation or arbitration boards by the British Board of Trade. Registration is optional, but any board so registered is required to "furnish such returns of the proceedings and other documents as the Board of Trade may reasonably require." Should it appear to the Board of Trade that no adequate conciliation board has been established to which may be submitted disputes which might arise in any locality or industry, the board is authorized to inquire into the causes and circumstances and to take such steps as are deemed expedient for the purpose of bringing the parties together with a view to conciliation and, on application of either party, to appoint one or more persons as conciliators, and on application of both parties to appoint an arbitrator. In 1911, following the great railway strike, an Industrial Council was established for the purpose of considering matters referred to it, especially with reference to disputes which would affect the principal trades of the country. The Industrial Council has no compulsory powers. Its primary function appears to be the encouragement of voluntary arbitration and the establishment of rules and regulations governing the procedure of unofficial boards. In 1915 and 1916 acts known as "The Munitions of War Acts," providing for conciliation and arbitration of disputes arising in munition manufacturing industries, were passed, and in making awards under these acts it is held that the rights of employers and employees engaged in these industries may not be exercised as freely as in times of peace, and although parties to the controversies are not compelled to abide by any award, they are called upon and expected, during the continuance of the war, to forego certain principles, in order that harmonious relationships may be maintained and production continued without interruption. In the settlement of minor disputes the English system appears to have been quite successful, and undoubtedly the number of serious industrial disputes has been somewhat diminished, but a large number of very serious disturbances have arisen notwithstanding the provision which has been made for voluntary arbitration.

New Zealand.—A statute enacted in New Zealand in 1894 provided for the compulsory arbitration of industrial disputes, and several other Australian states have since passed similar measures. An act of this character, passed by the commonwealth in 1914, was made applicable to disputes "extending beyond the boundaries of any one state." Under the provisions of the New Zealand act district boards of conciliation are created, on which board associations of employers and of workmen are equally represented, and an "imperial chairman" is elected by each board. In 1909 the act was amended so as to provide for the appointment of three commissioners of conciliation. When a controversy arises one of these commissioners endeavors to bring about a settlement and, if successful, he organizes a council of conciliation, consisting of two or more representatives of each party, to whom the matter is referred. Should such council fail to effect a settlement of the dispute, it is then referred to the Industrial Court, which consists of three members appointed by the governor for a term of three years, one of whom (the presiding officer) is a judge of the Supreme Court, another a representative of the employers, and another a representative of the employees. Cases also may be referred directly to the court without first having been referred to the council of conciliation. Pending consideration of a dispute by the court, strikes and lockouts are forbidden. The awards of the court are binding upon both parties and penalties are imposed for failure of either party to observe the conditions of the award. The factory inspectors are charged with the enforcement of the awards. For some years, under this system of compulsory arbitration, New Zealand was properly described as "a country without strikes," but during recent years strikes have been wholly prevented in that state, even though rather heavy penalties have been imposed for failure to observe the awards of the court. Some of these controversies, however, which have resulted in open conflict, have not come within the scope of the law.

Canada.— The Conciliation Act, passed by the Canadian Parliament in 1900, followed closely the phraseology of the British Act of 1896, which sought to encourage voluntary arbitration of labor disputes. The Railway Labor Disputes Act, passed in 1903, introduced the principle of compulsory investigation of railway disputes and recognized "the influence of an informed public opinion upon matters of vital concern to the public itself." In 1907, following a serious and protracted strike of coal miners in one of the Western provinces, the Industrial Disputes Investigation Act was passed, which provided for the compulsory investigation of all disputes involving 10 or

more persons employed in mining, or in connection with public service utilities. This act has since been amended so as to include all controversies arising in connection with the manufacture of military supplies. Employers and workmen are required to give at least 30 days' notice of an intended change affecting the conditions of employment with respect to wages and hours, and a strike or lockout is prohibited while the matters in dispute are being considered by an official board to which they shall have been referred for investigation. Heavy penalties may be imposed for failure to observe the provisions of the law. It is the duty of such boards to endeavor to effect a settlement by means of conciliation and mediation, and, if unable to do so, they are required to investigate the questions at issue, to prepare a report and to render an award which shall be made public, but they are not empowered to enforce the provisions of their awards. Although strikes in the industries covered by the act have not been altogether prevented, nevertheless the operation of the act has been remarkably successful, and it has been found that the weight of public opinion, based on authoritative facts determined after thorough investigation by such official boards, has been sufficient in most instances to induce the parties to the disputes to accept the awards of such boards without resorting to strike or lockout.

Norway.— During the year 1915 industrial unrest in Norway assumed alarming proportions and early in 1916 a lockout affecting approximately 20,000 employees in the metallurgical industries was declared by the mine operators and a general sympathetic strike in all branches of industry was imminent. This situation made it necessary for the government to take extraordinary action and Storting therefore passed, on 9 June that year, an act providing for compulsory arbitration of industrial disputes by an impartial commission, consisting of an equal number of representatives of employers and workmen. Provision is made for compulsory investigation and for a cessation of hostilities pending investigation and the rendering of an award. In this respect the act is similar to the Canadian Industrial Disputes Investigation Act of 1907, discussed above.

Sweden.— In accordance with the provisions of a law passed in 1907, Sweden is divided into seven districts, in each of which a "Conciliator," appointed by the Crown, shall endeavor to promote the settlement of industrial disputes and to advise and assist in the framing of agreements designed to preserve amicable relations between employers and workmen.

United States.— At least 29 of the 48 States have statutory provision for conciliation, mediation or arbitration in the case of industrial disputes. New York State and Massachusetts each created such a board as early as 1886. In 15 States a special board has been created for this purpose; in 11 States these functions are performed by boards, commissions or departments having other duties, and in three States provision is made for the appointment of special boards when deemed advisable. In no case are the awards of such boards binding, but in several States the boards may initiate action and have powers similar to those of the lower courts as respects the summoning of witnesses, compelling testimony, production of records, etc.

A Federal statute passed in 1888, applicable only to disputes between railroads and other transportation companies engaged in interstate commerce, created machinery for voluntary arbitration of railway disputes at the request of either party and for public investigation of such disputes upon the initiative of the government. This act remained practically a dead letter, and it was superseded in 1898 by the "Erdman Act," which provided for mediation and voluntary arbitration in the case of controversies arising between railroad companies and those employees directly engaged in the movement of trains, namely, engineers, firemen, conductors, trainmen, switchmen and telegraphers. By this act the chairman of the Interstate Commerce Commission and the Commissioner of Labor were designated "Federal Mediators," who, upon the request of either party, should first seek to bring about an amicable adjustment of controversies through mediation and, if unsuccessful, they should endeavor to have such controversies submitted to boards of arbitration to be established as provided for in the act. The "Newlands Act," passed in 1913 and now in effect, established the United States Board of Mediation and Conciliation consisting of a commissioner, an assistant commissioner and two other officials of the government, all of whom are appointed by the President. In general the provisions of the Erdman Law were re-enacted and provision was made for the appointment of six-member boards of arbitration composed of two representatives of each party to a controversy and two members representing the public, instead of the former three-member boards on which the neutral member alone held the deciding vote. Since the organization of the board in July 1913 and up to 18 Oct. 1916, the services of the board were requested in 61 controversies between railroad companies and their employees. Of this number 46 were settled by mediation, 11 by arbitration and four by mediation and arbitration. Two of these controversies were of unusual importance — one in 1913 involving over 92,000 conductors and trainmen in the eastern section of the country, and another in 1914–15 affecting about 55,000 locomotive engineers and firemen employed on railroads west of the Mississippi River. In each of several other controversies over 25,000 railway employees were involved. It has been authoritatively stated that in railway controversies "the results which have been accomplished under the Newlands Law have been without a parallel abroad." In only one case has the board failed to effect a peaceful settlement of a controversy referred to it. The recent refusal of the four large railway brotherhoods (Locomotive Engineers, Locomotive Firemen and Engineers, Railroad Conductors and Railroad Trainmen, together representing nearly 400,000 employees) to refer to arbitration the so-called "eight-hour" controversy, resulted in a deadlock, and in August 1916, a general railroad strike appeared to be imminent. In order to prevent such a public calamity President Wilson urged the immediate passage of legislation by Congress, then in session and early in September the Adamson bill was passed

by a large majority in both Houses. The act provided that, beginning 1 Jan. 1917, eight hours should, in contracts for labor and service, be deemed a day's work and the measure or standard of a day's work for the purpose of reckoning the compensation for services of all employees engaged in the operation of trains (with certain specified exceptions), and further provided for the appointment of a commission which should observe the operation and effects of the institution of such eight-hour standard work day for a period of not less than six months, nor more than nine months, and within 30 days thereafter should report its findings to the President and Congress. It was also provided that, pending the report of the commission and for a period of 30 days thereafter, the compensation of railway employees covered by this act should not be reduced below the present standard day's wage, and, for all necessary time in excess of eight hours, such employees should be paid at a rate not less than the pro rata for such standard eight hours of work. Penalties for violation of the provisions of the act were also provided. This law not only regulated the hours of labor of railway employees but also determined wage standards. As a measure fixing wages, its constitutionality has been questioned, and pending a determination of its constitutionalty several railway companies declined to observe the provisions of the act. Accordingly the chiefs of the four railroad brotherhoods called a strike to begin on 17 March 1917 on certain eastern railroads and to extend successively to other railroads until a general strike on all important railroads should result. Conferences between the railroad managers and the brotherhood chiefs were held, but without resulting in concessions by either party. Thereupon the President, through a special committee of mediation, urged that in view of the gravity of the international situation at the time, the two parties to the dispute, as a patriotic duty, should reach an immediate settlement of the controversy. Through the efforts of the mediators a postponement of the strike for 48 hours was secured, and on 19 March the railroad managers agreed to establish the basic eight-hour day and the threatened strike was averted. On the same day a decision of the Supreme Court upholding the constitutionality of the eight-hour law was announced. This decision established the principle that Congress has authority not only to regulate the hours of labor of employees engaged in interstate commerce, but also to determine wage standards. It was further established by the decision that: «The public right to have interstate commerce uninterrupted is a basic principle paramount to the interests of the railroads or of their employers, both in public service, and subject to the supreme, unrestricted power of Congress to take any action necessary to maintain freedom and uninterruption of interstate commerce.» A precedent having thus been established, it remains to be determined whether or not the settlement, by special legislation, of controversies which seriously endanger the public welfare shall prove as satisfactory or effective as adjustments through mediation and voluntary arbitration. See EIGHT-HOUR LAW; LABOR LEGISLATION; LABOR MOVEMENT IN AMERICA; LABOR UNIONS.

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ARBITRATION, International. A quasi-judicial mode of settling controversies between states which it has not been possible to settle through diplomatic negotiation. This method of adjudicating international disputes is an old one, many such instances having occurred in ancient times, notably among the Greeks and Romans. It has been frequently resorted to in modern times and the increasing disposition in late years to employ it justifies the hope that it may ultimately take the place of armed force as the accepted method of determining international controversies. According to Dr. W. Evans Darby in his 'Modern Pacific Settlements,' six international controversies were settled by arbitration in the 18th century; 471 in the 19th and 63 during the first three years of the present century. Since the beginning of our national existence some 83 disputes between the United States and some 24 different countries have been amicably settled through the decisions of mixed commissions or arbitral tribunals. Of the pecuniary awards made in these cases, 74.8 per cent, or a total of $69,501,682, were

made in favor of the United States, and 25.2 per cent, or a total of $23,353,762, were made against the United States. Numerous boundary disputes have been settled in this way; the Alabama claims controversy with Great Britain, growing out of the Civil War; the fur-seal controversy; and several fisheries disputes with Great Britain are examples of other important differences which have been arbitrated.

The history of international arbitration has gone through an interesting evolution. In the beginning bilateral arbitration treaties and general international conventions for the pacific settlement of disputes were unknown. Whenever two states wished to arbitrate differences existing between them they entered into a special agreement called a *compromis*, which defined the nature of the controversy, named the arbiters or designated a mode of selecting them, set forth their powers and laid down the rules of procedure by which they were to be guided in reaching a decision on the points at issue. Early in the 19th century the practice of inserting an arbitral clause in general treaties became common. This clause usually stipulated that in case a difference of opinion should arise regarding the interpretation of the treaty or some one of its provisions, the contracting parties would submit the question to arbitration. Thus the duty to arbitrate in certain cases was made obligatory. It has been stated that 142 such treaties have been entered into by the countries of America since 1832. The next step was reached when states began to conclude permanent arbitration treaties with one another which provided for the settlement by this mode of all disputes of a certain character which might arise in the future between the contracting parties. Finally, The Hague Peace conferences of 1899 and 1907 adopted general conventions for the pacific settlement of international disputes and provided for the creation at The Hague of a so-called permanent court of arbitration to which the contracting parties might submit their differences.

The first arbitration treaty concluded between the United States and a foreign power was that of 1897 with Great Britain. This treaty provided that certain classes of disputes which might arise between the two governments should be submitted to the arbitration of judges to be appointed according to a mode prescribed by the treaty and in accordance with certain rules of procedure which it laid down. The Senate, however, declined to give its advice and consent to the ratification of this treaty and it never went into effect. In 1905 President Roosevelt negotiated a number of arbitration treaties with foreign powers, but they were ratified only after the Senate had amended them in important particulars. The amendments being unacceptable to the President, he refused to lay them before the other parties for their approval. In 1908 arbitration treaties were concluded between the United States and France, Switzerland, Mexico, Denmark, Italy, Great Britain, Norway, Portugal, Spain, Sweden, the Netherlands and Japan and these were duly ratified by the Senate. Similar treaties have since been concluded with various other foreign powers, so that at the present time arbitration agreements exist between the United States and 28 different countries, or more than half the sovereign states of the world. In 1915 Brazil was a party to 33 such treaties, Italy to 25, Portugal to 18, Salvador to 20, Spain to 31, etc. Between 1902 and 1915, 164 arbitration treaties were concluded between the various powers of the world, and at the outbreak of the European War the German Empire was the only great power which was not a party to one or more arbitration agreements.

The majority of these treaties provide that differences of a legal nature which it may not have been possible to settle by diplomacy shall be referred to the permanent Court of Arbitration at The Hague (see HAGUE COURT, THE). Disputes, however, which affect vital interests, the honor or the independence of the contracting parties, or which involve the interests of third parties, are generally excluded from the provisions of the treaties, and there is therefore no obligation to submit them to arbitration. These exceptions are obviously quite elastic and it would be possible for one of the contracting parties, by a liberal interpretation of the terms "honor" and "vital interests," to avoid the obligation to arbitrate any dispute which it might choose to regard as one which involved its "honor" or "vital interests." In 1911 President Taft concluded treaties with several powers, the purpose of which was to remove the possibilities of evasion which these expressions create. In general, these treaties provided for the arbitration of all differences which were "justifiable in their nature by reason of being susceptible of decision by the application of the principles of law and equity," but they were radically amended by the Senate, in consequence of which they were dropped by the President.

Lange, in his work entitled 'Union Interparlementaire; l'Arbitrage obligatoire en 1913,' thus summarizes the scope of the existing arbitration treaties:

1. Arbitration of all disputes without reserve — 36 bipartite treaties.
2. Arbitration of all disputes subject to reserve of constitutional provisions — 13 treaties.
3. Arbitration of all disputes except those affecting vital interests, honor, or independence, or the interests of third parties — 46 treaties.
4. Arbitration of all disputes of a legal nature or those relative to the interpretation of treaties — 65 treaties.
5. Arbitration of differences relating to the interpretation or application of international law or conventions — 44 treaties.

As stated above, the first Hague conference of 1899 adopted a convention for the pacific settlement of international disputes, and the conference of 1907 revised and extended in certain particulars the earlier convention. These conventions were ratified or adhered to by practically all the states of the world, and being of unlimited duration, they are permanent. The conventions provide for the creation of a permanent Court of Arbitration to meet at The Hague for the decision of cases that may be referred to it, and through the generosity of Mr. Andrew Carnegie a palace has been erected there for the holding of the sessions of the court and for

the housing of its permanent offices. The conventions stipulate that each contracting power shall select not more than four persons, of known competence in questions of international law and of the highest moral character, to constitute a panel from which arbiters may be selected whenever any of the contracting parties shall agree to submit a dispute to the court for adjudication. The conference of 1899 formulated a code of procedure to be followed by the court in the hearing of cases submitted to it, and this code was revised and elaborated by the conference of 1907. Since 1899, 15 cases have been submitted to the court for decision, the first one being a dispute between the United States and Mexico concerning the so-called Pious Fund (q.v.) of the Californias. The decision was rendered 14 Oct. 1902 in favor of the United States and was duly carried into effect. The second case involved the question of whether Great Britain, Germany and Italy, three Powers which had blockaded the ports of Venezuela and seized certain of the Venezuelan customs houses on account of the refusal of the government of Venezuela to settle various claims preferred against it by those Powers, were entitled to priority of payment over other governments, including that of the United States, which also had claims against Venezuela, but which had not participated in the blockade of her ports. The decision was rendered 22 Feb. 1904 in favor of the blockading Powers. Among the other more important cases decided by The Hague Court were: The controversy between Germany, France and Great Britain on the one hand and Japan on the other, regarding certain perpetual leases in Japan (decided 22 May 1905); a dispute between Germany and France concerning aid alleged to have been given by the German consul to certain deserters from the French legation in Morocco (decided 22 May 1909); an important and long-standing dispute between Great Britain and the United States regarding the north Atlantic fisheries (decided 7 Sept. 1910); the dispute between France and Great Britain regarding the arrest by the French authorities at Marseilles of a fugitive named Savakar, who had escaped from a British vessel upon which he was being transported to India for trial (decided 24 Feb. 1911); and a controversy between France and Italy concerning the seizure by the Italian authorities of two French vessels during the Turco-Italian War (decided 6 May 1913).

In every case the decision of The Hague Court was accepted by the parties and was duly carried into effect. It soon became evident, however, that the organization of the court was defective. In the first place, it was not a court in the true sense of the word, but simply a panel of names from which the judges were to be selected by the parties whenever disputants had occasion to resort to the court. This involved long and expensive delays; besides, under such an arrangement, the court lacked permanency and continuity. These defects were the subject of serious consideration at the second conference in 1907, and with a view to remedying them, the conference adopted a convention providing for the creation of a permanent court of arbitral justice to be composed of judges appointed for terms of 12 years and to be paid regular salaries. The proposed tribunal was intended to be not merely a list of names kept at The Hague, but a fully organized body which was to meet once a year and to proceed with any cases which might be on its docket. It would not be necessary, therefore, to constitute a court every time a case was to be decided. Unfortunately, however, it proved impossible for the powers to agree upon the size of the court and the mode of selecting the judges. The smaller states at the conference insisted on equality of representation in the court, the effect of which, had their contention been admitted, would have been to create a tribunal of such size as to be unworkable. Various modes were proposed for selecting the judges and insuring some representation to all the powers, but no agreement was ever reached, and as a consequence the proposed court remains unorganized. The so-called permanent court provided for by the conventions of 1899 and 1907, however, may still be called into existence whenever recourse to it is desired.

The desirability of establishing a general system of compulsory arbitration has been much discussed in recent years and various projects with this end in view have been put forward. In 1890 the first Pan-American conference at Washington adopted a project for a general treaty of obligatory arbitration but it was never ratified by the states represented at the conference. At both The Hague conferences of 1899 and 1907 several projects for limited obligatory arbitration were proposed, but largely on account of the opposition of Germany they were defeated. The Russian proposal of 1899 provided for *inclusive* obligatory arbitration for differences involving pecuniary claims and those relating to the interpretation of treaties. In 1907 a similar, but more elaborate, project proposed by Portugal was discussed, but like the project of 1899, it was defeated. At the latter conference a project of *exclusive* obligatory arbitration was proposed — one which provided that "differences of a legal nature and primarily those relating to the interpretation of treaties" should be submitted to arbitration, provided they did not involve the vital interests, honor or independence of the disputing parties, or did not affect the interests of other states not parties to the dispute. This project had the support of a large majority of the states represented at the conference, but it was dropped mainly because of the opposition of Austria-Hungary and Germany. Nevertheless the conference of 1907 unanimously adopted a *vœu* admitting the principle of compulsory arbitration and declaring that certain differences, particularly those relating to the interpretation of treaties, might be submitted to arbitration without restriction. Finally, the conference, in adopting the Porter convention respecting the limitation of the employment of force for the recovery of contract debts, in effect sanctioned obligatory arbitration for one class of disputes.

It is apparent from the above summary that the movement looking toward the substitution of judicial methods in the place of armed force for the settlement of international disputes has made remarkable progress in re-

cent years. The obstacle which has stood in the way of further progress has of course been the feeling among states that they cannot consent to submit their international controversies to the decision of judges representing other nations without compromising their sovereignty and running the risk of surrendering their rights. If every nation which becomes involved in a controversy with another were absolutely certain of finding an impartial and unprejudiced tribunal to which it could resort with the certainty of obtaining justice, there would be little reluctance to adopt this method of settling disputes. As yet, however, no means has been discovered by which the selection of competent arbiters without national prejudices and sympathies can always be assured. The method provided by The Hague conventions for the constitution of an arbitral tribunal has not escaped criticism. Its members are to a certain extent under the control of the governments which select them and therefore tend to represent the views of their governments; in some instances, indeed, they have been regular legal or diplomatic officials. Greater independence and impartiality might be obtained by forbidding the appointment as members of the court of persons holding official positions under the government which they represent. Furthermore, it might be desirable to forbid any judge of the court from practising before it; it might, indeed, be desirable to go still further and prohibit any citizen of a disputing state from sitting in a case in which his government is a party; finally, a more advanced step, which is quite in line with sound judicial theories, would be to exclude the parties from choosing their own judges, this, because so long as they are allowed to do so they will appoint representatives who are prepossessed in favor of the claims of their own government. In short, arbiters so chosen are more likely to assume the rôle of advocates rather than that of judges. It would seem that if The Hague Court were constituted according to these principles, and if, in addition, the judges were appointed for life and were paid salaries commensurate with the dignity and importance of their positions, we should have a tribunal composed of men as nearly independent and free from prejudices as it would be possible to obtain. See HAGUE COURT, THE; INTERNATIONAL LAW; MEDIATION; PAN-AMERICAN CONFERENCE; TRIPLE ALLIANCE; TRIPLE ENTENTE.

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ARBOGA, är-bō'ga, a Swedish city, once important commercially but now only of historical interest from having been at one time a residence of the royal family of Vasa, the scene of church assemblies and national diets and for the antiquities in its neighborhood. Pop. about 5,250.

ARBOLEDA, är'bō-lā'dą, Julio, South American poet and statesman: b. Barbacoas, Colombia, 9 June 1817; d. 1862. He was educated in Europe and on his return to Colombia engaged in journalism. In the various Colombian revolutions he was a liberal Conservative and more than once declined the vice-presidency of the republic. His poems are much esteemed in Spanish-American literature.

ARBOR DAY, an annual tree-planting day appointed by nearly every State and Territory of the Union, sometimes as a legal holiday and sometimes merely advisory, to assist in foresting or reforesting scantily-wooded tracts or shading or beautifying towns. It is generally in special connection with the public schools, to impress children with the importance of forestry and natural beauty in our civilization. The date depends on the climate of different sections and is absolutely fixed in but few; most northern States hold it in April or early in May; Arizona, Texas and Alabama in February, the two latter on Washington's birthday; Florida in January, Georgia in December and New Mexico in March; many make it optional either with the State or with localities, and West Virginia holds it twice a year, in spring and fall. It arose from the alarm felt by the most far-sighted public men over the rapid and reckless deforestation of many parts of the Union, and the prospects of its extending to all the States, and a realization of what that deforestation meant to the future welfare and development of the United States (see FORESTRY). Most civilized governments at different times have looked after their forests to assure a supply of timber for naval construction; New Hampshire and New York, even in the colonial period, felt it needful to check the inroads on them; the United States government at the beginning of the 19th century bought timber lands and a quarter of a century later authorized the President to take measures for their preservation; and about the same time the Massachusetts Society for Promoting Agriculture offered prizes for forest planting. But the first widespread realization of its importance was caused in 1864 by the notable book of George P. Marsh (q.v.), the eminent American scholar and diplomat, entitled 'Man and Nature'; the chapter on "The Woods" aroused especial attention and in 1865 Birdsey G. Northrop, then secretary of the Connecticut Board of

Education, suggested that States might profitably plant trees every year at the proper time, or supervise their planting. The subject brought out several books and many articles; the late Dr. Franklin B. Hough, the first Forest Commissioner, publishing a work upon it as early as 1873. But the first to propose a regular Arbor Day for the purpose was J. Sterling Morton, late Commissioner of Agriculture, then of Nebraska, who in 1872 succeeded in inducing his almost treeless State to set apart a day for the purpose. Great enthusiasm was aroused and over a million trees were planted that year. In 1885 it was made a legal State holiday on 22 April, Mr. Morton's birthday. The movement did not at first spread very rapidly, though some localities took it up; the first States to copy the legal enactment were Kansas and Tennessee in 1875, and the next year Minnesota. It was six years before another joined, Ohio in 1882, followed by West Virginia in 1883; then the tide began to rush in and within five years 26 more States and Territories had adopted the observance. See FORESTRY; FOREST SERVICE and consult Schauffler, R. H., (ed.) 'Arbor Day' (1909).

ARBOR VITÆ (Latin, "tree of life"), the designation of several trees belonging to the family PINACEÆ and allied to the cypress. The genus consists of evergreen trees and shrubs, with flattened branchlets and small, imbricated or scale-like leaves. The common arbor vitæ (*Thuja occidentalis*) is a native of eastern North America and reaches a height of 50 feet in favorable locations. The cones are small; the young twigs have an agreeable balsamic smell; the wood is soft and light, but tough and durable. The other North American species is *T. Plicata*, found on the Pacific coast from the region of San Francisco Bay north to Alaska. The Chinese arbor vitæ (*T. orientalis*) is often cultivated. Its upright branches and larger cones easily distinguish it from the former. It yields a resin which was formerly thought to have medicinal virtues, like the wood and young twigs of *T. occidentalis;* hence the name — arbor vitæ.

ARBORETUM (Latin *arbor,* a tree), a place set apart for the cultivation of different trees and shrubs for scientific or educational purposes. See BOTANIC GARDENS; FORESTRY.

ARBORICULTURE, the scientific cultivation of trees. It embraces that part of horticulture which treats of the planting and cultivation of ornamental and fruit trees and that part of forestry known as sylviculture. For the horticultural growing of various trees see under the corresponding special headings. See also FORESTRY.

ARBUTHNOT, John, Scotch physician and author: b. Arbuthnot, Kincardineshire, Scotland, 29 April 1667; d. London, 27 Feb. 1735. Arbuthnot was the eldest child of Alexander Arbuthnot, rector of Arbuthnot, and Margaret [Lammy] Arbuthnot. Little is known of John Arbuthnot's early life; he was probably educated at Marischal College, Aberdeen, but almost nothing else can be stated of his minority. It is known, however, that as a result of the Revolution of 1688, his father who was a stout supporter of the Stuarts, lost his preferment and, on his death in 1691, his sons were obliged to seek their fortunes abroad. John went to London, where he supported himself by teaching mathematics. The following year he probably published a little book entitled 'The Laws of Chance,' but it may not be definitely assigned to him. In October 1694 he entered University College, Oxford, and in September, two years later, took his doctor's degree in medicine at Saint Andrews. Shortly afterward, in all probability, he settled in London for the remainder of his life.

Arbuthnot's first important work was 'An Examination of Dr. Woodward's Account of the Deluge' (1697), a work in which Arbuthnot showed his interest in questions of science and the candor and fairness of his mind. His next piece, 'An Essay on the Usefulness of Mathematical Learning,' appeared in 1701. His progress in distinction was so rapid that in 1704 he was elected a Fellow of the Royal Society and the following year was made Physician Extraordinary to the Queen. In 1709 he was appointed Physician in Ordinary to the Queen, and the following year was admitted as Fellow to the College of Physicians. His publications of the period are of a somewhat miscellaneous character: 'Tables of the Grecian, Roman and Jewish Measures, Weights and Coins, Reduced to the English Standard' (1705), 'A Sermon Preached to the People at the Mercat-Cross of Edinburgh; on the subject of the Union' (1706) and 'An Argument for Divine Providence, taken from the Constant Regularity Observed in the Births of Both Sexes' (1710). Because of his well-known good humor, fairness of mind and ability he was frequently named to settle vexed questions and rival claims.

Arbuthnot is remembered in English literature chiefly for the friendships which he made and the work that he did during the next four years. He became acquainted with Swift in 1711 and with Pope two years later, and both friendships were close and life-long. It was possibly under the influence of the former that he contributed several interesting satires to the support of the Tory administration. In February 1712 appeared 'The Story of the Saint Albans Ghost, or the Apparition of Mother Haggy,' a satire upon the Duke and Duchess of Marlborough. In the spring and summer of the same year there appeared in five instalments, the much more important 'Law is a Bottomless Pit,' called later and better known as 'The History of John Bull.' Both were attributed to Swift and have been included frequently in his published works, in spite of his denial of them. 'John Bull' is undoubtedly one of the masterpieces of English political satire of the milder sort. It pursues throughout the method of the narrative parts of Swift's 'Tale of a Tub' and it gives an account of the history of English foreign politics of the time, but its quality is more genially humorous than violently satirical. It is particularly notable for the name and character of John Bull, which Arbuthnot created. In October of the same year Arbuthnot published 'The Art of Political Lying,' a satire of an extraordinary rather than a dramatic cast.

The friendship of Arbuthnot with Swift, Pope and the Tory leaders resulted in a society for the diversion of its members in times of political turmoil. Out of that sprang the

Scriblerus Club. The object of the club was, in the words of Pope, "to have ridiculed all the false tastes in learning, under the character of a man of capacity enough, that had dipped into every art and science, but injudiciously in each." The members were Arbuthnot, Swift, Pope, Gay, and Parnell, but almost exclusively to Arbuthnot alone belong the 'Memoirs of the Extraordinary Life, Works, and Discoveries of Martinus Scriblerus,' probably written in 1713–14, but published in 1741 by Pope. The 'Memoirs' are usually included in Pope's works, who wrote only the excellent 'Art of Sinking in Poetry.' The reason that so many of Arbuthnot's works have been attributed to other writers is that literature was to him a diversion and he made little attempt to keep his writings.

On the death of Queen Anne in 1714, Arbuthnot, along with the Tory ministers and their supporters, lost their places at court, but Arbuthnot retained his favor with influential people. In his profession he was honored by being made, in 1723, Second Censor by the College of Physicians and, possibly in 1730, Physician to the Queen. His writing up to his death consisted of an amplification of his 'Tables of Ancient Coins' (1727), some satirical notes, with Swift, to the 'Duncaid' (1729), a popular 'Essay Concerning the Nature of Ailments and the Choice of Them' (1731), to which the following year he added 'Practical Rules of Diet,' an 'Essay Concerning the Effects of Air on Human Bodies' (1733), and a poem, 'Know Thyself' (1734). Alone and in collaboration with his friends he probably wrote a number of satirical pieces, which are often included in his works but which cannot be definitely assigned to him. The last 10 years of his life were marked by several illnesses, but he never lost his cheerfulness and good-nature. A few weeks before his death appeared Pope's masterly 'Epistle to Dr. Arbuthnot,' which is interesting in part as a proof of the esteem in which he was held by his friends and by which he is best known to the average reader.

Bibliography.— The chief source of information about Arbuthnot is George A. Aitken's 'The Life and Works of John Arbuthnot' (Oxford 1892), wherein all that is definitely known to be Arbuthnot's is included except the technical treatises. The other chief source of information is Leslie Stephen's article in the 'Dictionary of National Biography.' References to the history of the Scriblerus Club and Arbuthnot's relations to the great men of letters of the time are to be found in the separate lives of these men and in the literary histories.

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ARBUTHNOT, Marriot, English admiral: b. 1711; d. 1794. With Sir Henry Clinton he captured Charleston, S. C., 20 May 1780, after the city had withstood a long siege, and commanded in a sea fight with a French fleet off Cape Henry in March 1781.

ARBUTUS, ăr'bū-tŭs, the designation of a genus of about 20 species of shrubs and small trees, mostly evergreen, of the family *Ericaceæ*, natives mainly of Europe and North America. The species, many of which have smooth, red branches, are often used for ornamental purposes. *A. unedo*, the strawberry tree, a species from southern Europe, is often planted in California, its profusion of white or rosy flowers and strawberry-colored fruits which ripen during the blossoming period of the following year being greatly admired. In Spain this fruit is used to make sugar and a kind of liquor. *A. menziesii*, the madrona, a native of the Pacific Coast States, attains a height of about 100 feet and is the hardiest and perhaps the handsomest species of the genus. *A. arizonicus*, another American species, which sometimes reaches a height of 50 feet, has white bark on the trunk, red branches, pale-green leaves, loose panicles of white flowers and dark orange-red fruits.

ARBUTUS, Trailing, an evergreen creeping plant (*Epigæa repens*) of the family *Ericaceæ*, growing in shaded sandy and rocky soils especially in pine woods, from Newfoundland to Florida and westward to Minnesota. It is known in New England as the Mayflower and in the southern United States as ground laurel, and is everywhere prized for its fragrant rose-colored or white flowers.

ARC, a geometrical term denoting a portion of the circumference of a circle, often cut off by two lines which intersect it. The name is also applied to a portion of any other curve. The magnitude of an arc of a circle is stated in degrees, minutes and seconds, which are equal to those of the angle at the centre which it subtends. Hence, counted by degrees, minutes and seconds, the arc of elevation and the angle of elevation of a heavenly body are the same, and the two terms may be used in most cases indifferently. The straight line uniting the two extremities of an arc is called its chord. Equal arcs must come from circles of equal magnitude, and each must contain the same number of degrees, minutes and seconds as the others. Similar arcs must also each have the same number of degrees, minutes and seconds, but they belong to circles of unequal magnitude. Concentric arcs are arcs having the same centre. In mathematical geography an arc of the earth's meridian, or a meridional arc, is an arc partly measured on the surface of the earth from north to south, partly calculated by trigonometry. By these measurements the earth was discovered to be an oblate spheroid.

ARC, Electric. See ELECTRIC LIGHT.

ARC, Joan of. See JOAN OF ARC.

ARCA, a term applied to a genus of conchiferous mollusks, the typical one of the family *Arcadæ*. The shell is strongly ribbed or cancellated, hinge straight, with very numerous transverse teeth. They are universally distributed, but are commonest in warm seas. They inhabit the zone from low water to 230 fathoms. The fossil species are found in the United States, Europe and southern India.

ARCADELT, Jacob, Flemish composer: d. Paris 1570 or 1575. The date of his birth is uncertain, but it was probably during the first quarter of the 16th century. His works are among the finest examples of contrapuntal music of the time He assisted in founding the classical Italian school of music. From 1539 to 1555 he was engaged as singer and teacher in the Papal Chapel at Rome. He composed madrigals, masses and motets. He entered the service of Cardinal Charles, Duke of Guise, in

1557, and accompanied the latter to Paris, where he died. Consult Ambros, 'Geschichte der Musik' (Vol. II, Leipzig 1909); Burney, 'General History of Music' (Vol. III, London 1789).

ARCADIA. The 'Arcadia' of Jacopo Sannazaro (1456–1530) is the most celebrated of the Italian pastoral romances of the Renaissance. Composed between 1481 and 1486, it first appeared in a pirated edition at Venice in 1502, in an authorized print at Naples in 1504 (edited by Summonte), finally in the Aldine edition of Venice 1514. It is this text of Aldo Manuzio that has formed the basis of the numberless more recent editions of the work. A large variety of considerations have tended to give the 'Arcadia' a greater eminence in literary history than for intrinsic value it would seem to deserve. It is the most considerable production of the Neapolitan school of literature in the 15th century, a group comprising Pietro Jacopo de Jennaro, Caritheo, Pietro Antonio Caracciolo and Giannantonio Petrucci. This school, aside from affirming the Petrarchistic trends in Italian poetry, is important as showing in diction the curious linguistic hybridism that preceded the constitution of the national Italian language on a classic basis (imitation of Dante, Petrarch and Boccaccio). The 'Arcadia,' in fact, has in its earlier forms a distinct Neapolitan coloring. But in successive redactions, Sannazaro made it conform more and more to the language and style of the Tuscan Boccaccio; and the triumphant classic purism of the 16th century came to recognize the 'Arcadia' as one of the supreme models of linguistic correctness and good taste. The Renaissance doctrine of "imitation" likewise enthroned this romance of Sannazaro as the perfect model of the pastoral "genre," especially as regards the eclogue. The imitation of the 'Arcadia,' beginning with Serafino dall' Aquila, extends in Italy through Castiglione, Tasso, Guarini and lesser men down to the end of the 18th century. Castiglione himself seems to have introduced the 'Arcadia' to the Spanish court. Its popularity in Spain is attested by imitations by Garcilaso de la Vega, by Montemayor (*Diana*), by Cervantes (*Galatea*) and hosts of others. In France the 'Arcadia' inspired the 'Bergerie' of Remy Belleau and to some extent also the work of Ronsard. For England we have the 'Shepherd's Kalendar' of Spenser and the 'Arcadia,' no less, of Philip Sydney. To be sure, in all these epigones of Sannazaro's work, it is not always easy to separate the influence of the 'Arcadia' from that of its own sources. Sannazaro composed it directly on the model of Boccaccio (e.g., 'Ameto'), utilizing also Virgil, Ovid, Theocritus, Bion and Moschus. The later pastorals, moreover, borrowed largely from the Spanish romance.

The 'Arcadia' tells the story of an idyllic, unhappy love, to which legend assigns a biographical value for the poet. Sincerus (Sannazaro) driven wandering by love, goes breathing the sighs of his melancholy spirit through the groves of Arcadia, inhabited by the most erudite, æsthetic and delicately sensualistic shepherds imaginable. Sincerus is warned by an evil dream that his "nymph" is in danger; he returns to his home, to find her dead. Around this tenuous plot is arranged a whole gallery of word-paintings, brilliantly colored and elaborated in detail. The work is suffused with tints of quintessential delicacy; we meet there only the softest murmurs, the tenderest emotions, the most fainting languors. There is a constant tickling of the senses with stimuli attenuated to the point of vanishing, but calculated to arouse in souls properly "sublimated" greatest intensity of emotional strain. Thus the 'Arcadia' expresses the ideal of æsthetic refinement held up before the court society of Italy, and by the Italians passed on as the foundation of good manners to France and the rest of the world. However, such sublimity always totters on the brink of the ridiculous. There is a vein of possible humor underneath which alone can save such artificiality. The self-consciousness of this humor is the saving quality of Tasso's pastoral art; the lack of it constitutes the prevailing defect of the 'Arcadia' of Sannazaro.

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ARCADIA. 'The Countesse of Pembroke's Arcadia,' a long and elaborate romance by Sir Philip Sidney, was written during or before 1580, and sent in scraps of manuscript by the author to the Countess, his sister. Its five books, in prose, with "eclogues" in verse after each in the manner of Sannazaro's 'Arcadia,' told the story of a king who, to avoid the fulfilment of a threatening oracle, retired with his wife and two daughters to a lodge in the forest, but whose plan was frustrated by the arrival of two princely heroes, so that after many chivalrous and pastoral episodes all the virtuous were made happy. The contents — the travels, shipwrecks and hairbreadth escapes, the courtships, captivities, trials at law and harangues, the disguises and mistaken identities, deaths real and deaths feigned, rebellions and tyrannicides, children lost and restored, in a word, the strange turns of love and fortune — were partly Sidney's invention, but were chiefly derived from romances of chivalry (in particular the 'Amadis of Gaul') and from the Greek romances (in particular the 'Æthiopica' of Heliodorus and the 'Clitophon and Leucippe' of Achilles Tatius). The narrative was straightforward and easy to follow.

This original or "Old" 'Arcadia' had circulated in manuscript for several years when Sidney began a revision, which he left unfinished at his death. He had, however, recast about half his old material, and cast a considerable quantity of new material with it into the elaborate and complex structure of Heliodorus's 'Æthiopica,' which conceals the key of the narrative, overlays, interlaces and interrupts the main story with many episodes, and inverts the chronological order to conform to the antique epic convention *in medias res*. The first edition, 1590, quarto, consists of this new version only. The second edition, published by the Countess and her friends in 1592, consists, first, of the new version as far as it goes, that is, to the middle of the third book; next, of a few words of transition; and, finally, of the remainder of the old third book and the whole of the old fourth and fifth books.

This patchwork is the current or standard version. The original 'Arcadia' has never been printed, though several manuscript copies of it were found by Bertram Dobell, the London bookseller and scholar, in and after 1907.

As a romance of love and adventure the 'Arcadia' is still good reading, despite the riddle of its plot, which one soon "gives up." Its sweet, rhythmical style, full of Renaissance imitations of late Greek and Roman rhetoric, full of antitheses and conceits and lofty sentiment and show-pieces of description and oratory, is one phase of the Italianate style of Elizabethan courtly literature.

The intrinsic merit of the 'Arcadia' gave it deep literary influence. Elizabethan books allude often to both the old and the new versions; Greene and Lodge imitated its plot and structure in several prose romances; Shakespeare borrowed from it the story of Kent in 'King Lear'; Beaumont and Fletcher derived from it the plot of 'Cupid's Revenge'; King Charles I adopted from it his prayer on the eve of execution. It was often reprinted in the 17th century, when also it reached France in translation, and helped in the elaborate construction of the French "heroic romances." It is the only work of Elizabethan fiction that continued to be popular throughout that century and into the 18th, where its influence—certain as regards Richardson—has yet to be fully worked out. Scott's 'Ivanhoe' exhibits many borrowings. On the whole, the 'Arcadia' probably brought into English fiction that sustained elaboration of structure which distinguishes the novel from the short story and the picaresque tale. It is thus a literary prototype. Editions: 1590 (quarto); facsimile reprint, ed., H. Oskar Sommer (London 1891); ed. Albert Feuillerat (Cambridge 1912); 1592 version often reprinted, recently ed., Ernest A. Baker (London and New York 1907). Consult Dobell, Bertram, 'New Light on Sidney's Arcadia' (*Quarterly Review*, Vol. 211, pp. 74–100, July 1909); Wolff, Samuel L., 'The Greek Romances in Elizabethan Prose Fiction' (New York 1912, pp. 262–366, 461–64).

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ARCADIA, Fla., city and county-seat of De Soto County, 75 miles southeast of Tampa, on the Charlotte Harbor and Northern, the Seaboard Air Line and the Atlantic Coast Line railroads. The principal industries are cattle, orange and citrus fruit and vegetable farming, phosphate production, etc. It contains a city hall, county courthouse and two school buildings, and has 15 miles of asphalt streets. The city's two banks and a trust company have resources aggregating $225,000. In 1917–18, during America's preparation for entering the European War, two aviation camps were located at Arcadia. Pop. 6,000.

ARCADIUS, the first Emperor of the East: b. 377; d. 408. He was son of the Emperor Theodosius, on whose death in 395 the empire was divided, he obtaining the East and his brother Honorius the West. He proved unable to govern for himself and was a mere tool, first in the hands of Rufinus, then of the eunuch Eutropius, and then of his Queen, Eudoxia.

ARC DE TRIOMPHE DU CARROUSEL, ärk dė trę'ôñf dü ka'roo'zĕl. See ARCH, MEMORIAL AND TRIUMPHAL.

ARC DE TRIOMPHE DE L'ETOILE, ärk dė trę'ôñf dü la'twäl. See ARCH, MEMORIAL AND TRIUMPH.

ARC LAMP. See ELECTRICAL TERMS.

ARCESILAUS, är'kĕ-si'lôs, Greek philosopher: b. Pitane, Aeolis, 316 B.C.; d. 241 B.C. He studied philosophy at Athens and was largely influenced by Crates and Crantor. At the latter's death he became the head of the Academic School. Arcesilaus denied the certainty of intellectual and sensuous knowledge and recommended abstinence from all dogmatic judgments. In practice he held we must act on grounds of probability. He wrote nothing and confined his activities to expounding the Socratic method, yet he wielded a vast influence on philosophic thought. He was noted for his clearness of thought, his wit, facility of speech and amiable disposition and bearing both to his opponents and pupils. Consult Zeller, 'Geschichte der griechischen Philosophie' (Leipzig 1893).

ARCH, an architectural term denoting a structural form made up of a series of wedge-shaped stones or bricks so arranged over a door or window in an edifice for habitation, or between the piers of a bridge, as to support each other and to carry in addition the weight of the superstructure. These stones and bricks, of a truncated wedge shape, used in building arches, are called voussoirs. The side of an arch between the crown and the springer, or skewback, is called its haunch or flank, and by old English writers of the 16th century, its hanse. The highest part of the arch is called its crown, or by the old English authors, the scheme or skeen, from the Italian *schiéna*, the back. The lowest voussoirs of an arch are called springers, or skewbacks, and the central one, the keystone. The under or concave side of the voussoirs is called the intrados, and the outer or convex one the extrados of the arch. A chord of the arch at its lower part is called its span, and a line drawn at right angles to this chord and extending upward to the under side of the keystone is called its rise. The impost of an arch is the portion of the pier or abutment whence the arch springs; the thrust of the arch is its outward pressure against the abutments. The voussoirs are also called ring-stones. The spandrel is the part above the haunches, or, in a bridge, the part between the arch-ring and the roadway. If the height of the crown of an arch above the level of its impost be greater than half the span of the arch, the arch is said to be surmounted. If, on the contrary, it be less, the arch is said to be surbased. The curved arch was known to the Assyrians and the old Egyptians. Sir J. G. Wilkinson considers that it existed in brick in the reign of Amenophis I, about 1540 B.C., and in stone in the time of Psammetichus II, 600 B.C. The evidence is derived from the ruins of actual buildings, but paintings appear to carry the arch back to about 2020 B.C. There is no mention of the genuine arch in Scripture, the term "arches," in Ezek. xl, 16, being a mistranslation. The round arch was brought into extensive use by the Romans and prevailed everywhere until

the 12th century A.D., when the arch pointed at the apex, and called in consequence the pointed arch — the one so frequently seen in Gothic architecture — appeared in Europe as its rival. The forms of both curved and pointed arches may be varied indefinitely. Of the former may be mentioned the horseshoe arch, a name which explains itself, and the foil arch, from Latin *folium*, a leaf, of which there are the trefoil, the cinquefoil and the multifoil varieties, so named from the plant-forms after which they are modeled. Other arches are the equilateral, in which the centres of the circles whose intersection constitutes the pointed arch coincide with the angular points at the two sides of the base; the lancet, in which the centres of the circles fall beyond these points; the drop arch, where they fall within the base; and the segmental arch, the sides of which constitute segments of circles containing less than 180 degrees. Besides these there are several other varieties of arch distinguished by their respective forms. The names applied to arches may be divided into several classes, as referring to geometric or familiar forms, style or position in the building. The following are different geometrical forms: The flat arch, with voussoirs radiating from one centre. Arches with one centre are: semi-circular, segmental, horseshoe. Arches with two centres are: the equilateral pointed arch, where the centres of the circles coincide with the angular points at the two sides of the base; the drop arch, where they fall within the base; the lancet, where they fall outside of it, and the pointed horseshoe. The common three-centred arch is called basket-handled arch, this being the form generally used instead of an ellipse. Four-centred, six-centred and other similar forms are occasionally used. The names horseshoe, lancet, basket-handled, etc., are given because of their resemblance to familiar forms. Gothic, Roman and Moorish arches are names given because these forms were used in those architectural styles. Certain names are given with reference to the position of the arch in the building, such as discharging or relieving arch, where the arch is placed over a lintel to carry pressure to the sides.

Examples of arches are the Cloaca Maxima, built about 641 B.C., with three concentric rings of voussoirs, inside diameter, 14 feet; the Pont du Gard, built by Agrippa, 19 B.C., which has semi-circular arches, built of Pozzuolani concrete with stone or brick facing. The longest masonry span in Europe is the railway bridge over the Pruth, Jaremcze, Austria, 213 feet wide with a rise of 59 feet, and built in 1892. This shows hollow spandrels, which are constructionally and artistically correct. The Cabin John Bridge, near Washington, D. C., which carries an aqueduct and highway, 220 feet. The Wheeling, W. Va., Main St. Bridge, built in 1892, 159 feet long, 28 feet rise, is deceptive, as spandrels are hollow, but appear to be solid. The great arch now built for the cathedral of Saint John the Divine, New York, is of masonry resting on the top of piers 86 feet high. The span is 114 feet from outside to outside of voussoirs. In 1896 was built the first large concrete arch in the United States, 40 feet span, seven feet rise, all of concrete. This was for a highway bridge. There is also a 60-foot arch of steel-concrete in Franklin Bridge, Forest Park, Saint Louis, Mo. "Concrete reinforced" is the name given to the combination of concrete with steel or iron in building. Steel-concrete, armored concrete, *béton armé, ciment armé*, are various terms for such construction, now coming into frequent use.

The Melan arch system was developed by Prof. Joseph Melan, using stiff steel ribs or beams embedded in concrete to form the arch ring, following Austrian experiments. Examples of Melan arch are found in Eden Park, Cincinnati, Ohio, 70 feet span; railway bridge over Southern Boulevard, Detroit, Mich.; road bridges over the Passaic, Paterson, N. J.; Kansas Avenue, Topeka, Kan., this being the longest, having five arches, one of 125 feet, two of 110 feet each, two of 97 feet each; Hyde-Park-on-Hudson for F. W. Vanderbilt, 75 feet span; a foot bridge in park, Stockbridge, Mass., 100 feet span, rise 10 feet, only nine inches thick at crown; three-hinged arch, Steyr, Hungary, span 137 feet, rise only nine feet, or one-fifteenth of span. The Monier method is concrete with wire netting embedded near the soffit. Arches of long span and slight rise in building construction are being made with the Guastavino system of cohesive construction, which is practically a revival of ancient and mediæval building methods. See ARCH, MEMORIAL AND TRIUMPHAL; BRIDGE; BUTTRESS; VAULT.

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ARCH, Memorial and Triumphal, a monumental structure erected in honor of some prominent person or memorable event. In the custom of temporarily decorating the gates of cities with garlands and trophies, on the return of a victorious general, we can find the origin of the triumphal arch. These are similar in form whether commemorating a peaceful event or a military triumph. In the time of the Roman republic temporary arches were erected in honor of triumphant generals. At that period also memorial arches or *fornices*, were erected in memory of some individual or to ornament a city, but it was not until the time of the empire that the triumphal arch, the *arcus*, came into use, to perpetuate the glory of a person who had obtained the honors of a triumph. Arches were often placed at the entrances of cities, becoming in such a position merely monumental forms of city gate. The usual form of triumphal or memorial arch employed a high and imposing semi-circular arch as its central motive, resting on heavy piers, which were decorated generally with Corinthian columns and other architectural details, statuary, and bas-reliefs. Above this was a heavy mass of stone-work or attic, on which was placed a suitable inscription. The arch of Titus, at Rome, is the most remarkable for its purity, the beauty of its sculpture and the harmony of its proportions. It was probably erected by Domitian in honor of Titus to recall his conquest of Jerusalem. In panels on the inner sides of the piers are sculptured, on one side the triumphant Titus on his *quadriga* surrounded by soldiers; on the other side the triumphal procession, with the spoils of the Temple, the sacred vessels and the seven-branched candlestick. At the foot of the Capi-

tol, at the side of the Forum, is the arch of Septimius Severus, erected in honor of this emperor and his two sons to commemorate their victories over the Parthians and the Arabians. It has small side arches reached by a few steps, and a large central arch. The most important arch in Rome is that to Constantine, which is similar to that of Septimius Severus. It was erected by the Senate and the Roman people in honor of Constantine. The arch of Trajan at Ancona was erected on a pier which serves as a base, and was a memorial of the completion of that port. It is said that another arch of Trajan at Benevento was erected to commemorate an extension of the Appian Way. In modern times the name "triumphal arch" is given to a structure of wood or staff decorated with flags, banners and floral designs, as a part of some public celebration, or in honor of some person; for example, the Dewey arch in New York. This is an outgrowth of the old Roman idea. Modern history has illustrations of many examples of this form of arch. Albert Dürer has made many engravings of the triumphal entry of the Emperor Maximilian, and of the arches erected in his honor. There are also illustrations of arches for Charles V at Boulogne; to Henry III at Lido, on his trip to Venice. Rubens made the designs for the triumphal arch for Ferdinand of Austria at Antwerp, and a large arch was erected to Louis XIV at the Barrière du Trône. There are also triumphal arches in Paris: the Arc du Carrousel near the Louvre, built by Napoleon I, now destroyed; Porte Saint Denis, built by Louis XIV; the large Arc de l'Étoile, dedicated by Napoleon to his soldiers and sailors; and Porte Saint Martin (1674); in Berlin the Brandenburgerthor at the entrance of the Thiergarten. In the United States there are arches of this character in Brooklyn, N. Y., and Hartford, Conn., and the Washington arch in New York.

Among celebrated arches of this character, mediæval and modern, may be named the following gateways: At Naples, the Arch of Alfonso of Aragon (1470), and the Porta Capuana; at Burgos, the Santa Maria; at Montpellier, a 17th century memorial of the revocation of the Edict of Nantes; at Milan, Della Pace; at Munich, Siegesthor (Victory Gate) (1850); and at London, the Marble Arch. See ARCH; GATEWAY.

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ARCH BRIDGES. See BRIDGE CONSTRUCTION, MODERN METHODS OF.

ARCH OF CONSTANTINE, a triumphal arch at the junction of the Via Sacra with the Via Triumphalis, Rome. It was erected in 315 A.D. in commemoration of Constantine's victory over Maxentius and is the best preserved monument of ancient Rome, probably because it was built by a Christian emperor. The inscription on its face is interesting to Christians as revealing the Emperor's conversion from paganism. (See ARCH, MEMORIAL). Consult Platner, 'The Topography and Monuments of Ancient Rome' (New York 1911).

ARCH OF SEPTIMIUS SEVERUS, a well-preserved triumphal arch, erected 203 A.D., in the Forum, Rome, to commemorate the victories of Severus over the Parthians. The arch is 75 feet high and 82 feet broad. Above the outer arches are panels representing the campaigns of Severus; the pedestals of the columns show groups of prisoners taken during the war. The arch was used as a stronghold in the Middle Ages and for a time in the 17th century the side passages were turned into shops. See ARCH, MEMORIAL.

ARCH OF TITUS, a memorial arch at Rome on the Via Sacra, erected in 80 A.D. in honor of the conquest of Judæa. It is richly sculptured and shows reliefs of Titus in triumph, with the plunder of the temple at Jerusalem, including the seven-branched candlestick and the table of showbread. In the Middle Ages the fortifications of the Frangipani were built up about the arch, and when these were taken down in 1822, the arch was also taken down and rebuilt as fears were entertained for its safety. See ARCH, MEMORIAL.

ARCH OF TRAJAN. 1. A well-preserved memorial arch at Ancona, Italy. It was erected by the Roman Senate in 112 A.D. to commemorate the new harbor works erected by Trajan. It has a single archway 29 by 46 feet. 2. A white marble arch erected at Benevento, Italy, in 114 A.D. to commemorate the completion of a new road to Brundisium by Trajan. It is 50 feet in height and its reliefs portray Trajan's victories over the Dacians. It is one of the best-preserved specimens of the Roman arch.

ARCHÆAN. See ARCHEAN.

ARCHÆAN, är-kē'ăn, **PERIOD,** a term applied to the most ancient division of the geological time-scale. The rocks referred to this period underlie the oldest sedimentary and fossiliferous strata and hence are often called the fundamental complex. They are entirely of crystalline character, consisting of granite and basic eruptives, gneisses and schists, all of which bear evidence of having undergone great disturbance and metamorphism, so that it is impossible to work out any order of stratagraphic succession that will apply to different regions. Their great uniformity of composition over wide areas, their marked characteristics which differentiate them from all other groups of rocks, and their basal position in the geological scale have led many geologists to believe that the Archæan rocks represent a portion of the original crust of the earth as it solidified from molten magma. While this view has not found universal acceptance, it is quite certain that if the first solidification of

the earth is still preserved anywhere, it is present in this formation. The Archæan rocks are known to occur in all of the continents, although in some regions they have been brought to the surface only after long periods of erosion during which immense thicknesses of overlying strata were removed. In North America they cover much of the region between the Arctic Ocean and the Great Lakes, and are also found in the Adirondacks, along the Appalachians and in the Rocky Mountains. They occur in many parts of Europe, especially in Scandinavia, France, Germany and Austria, in eastern Asia and in central Africa. See GEOLOGY.

ARCHÆOLOGICAL, INSTITUTE OF AMERICA, är-kẹ-ō-lŏj'ĭ-kăl, a society formed in 1879 for the purpose of promoting and directing archæological investigation and research. Under its direction several important excavations were conducted on the site of the ancient city of Assos. It publishes a bimonthly *Journal*, which is its official organ. It has a membership of 1,050.

ARCHÆOLOGY, är'kẹ-ŏl'ō-jĭ ("antiquity-study"), the history of antique human progress as inferred from relics of man's industry or presence, apart from written records. It is thus identical with history where there are no such records, and supplementary material for it when they exist. It is distinguished from anthropology as concerned chiefly with industrial and artistic rather than social and political progress. But its limit neither of date nor of subject can be sharply fixed. The antiquities of a country are relative to its present and its records; 400 years in Mexico brings us to pure archæology, 2,000 in Greece and Rome is almost this side of it, all west-Asian history belongs to it. Even written records, if inscriptions on stone or brick, or papyri, are archæological when pertaining to an extinct civilization; if classical, they are history, epigraphy, or palæography. Nor can we wholly dissociate the biological study of the bones found in a prehistoric camp, river drift or cave (palæontology), from that of the flints, worked bones, drawings, etc., found with them, as evidences of mechanical and intellectual progress (archæology), and the social organism implied by the camps, food, ruddle, etc. (anthropology). The genesis of the science restricted the name at first to remains of classical art and architecture, still often regarded as its most important section, through its illumination of classic literature; but general archæology does not merely supplement a developed history; it reveals the very existence of empires, nations, races, cultures, stages of human progress, otherwise unsuspected, and carries our knowledge far into the geological past.

The classical branch, whose material was relatively accessible and its bearing obvious, naturally originated first in the 18th century; general archæology is the creation wholly of the 19th century and has two independent origins. On one side it springs from the decipherment of the Egyptian hieroglyphs, unveiling a remote history implying a still more remote one and making scholars realize for the first time how futile were the distorted scraps of classical tradition. This was followed by excavations in Mesopotamia which uncovered the remains of the Assyrian culture, and by the decipherment of the cuneiform characters. Here it was first realized that archæology is the one branch of history (for numismatics is a department of archæology) that absolutely settles historical questions. A written statement may be a falsehood or mistake, but an inscription is conclusive as to its date and writer. On the other side, archæology springs from the examination of relics of antique man in burial mounds, kitchen middens, lake dwellings, caverns and river drifts, showing his coexistence with animals long extinct and in geologic ages long gone by. These two streams have gradually resulted in a vast storehouse of verified knowledge, not only unsuspected, but revolutionary of assertions previously supposed axiomatic. Briefly, archæology has shown that civilization is not a sudden mushroom growth of a few dozen centuries, from a single centre and a highly developed group, but a gradual evolution through enormous ages in all parts of the world, from that intermediate condition between apehood and manhood which we know must have existed, but of which no positively demonstrable evidence has been discovered. Savagery, as we know it, is a long step in advance.

In place of the convenient division into "civilized, half-civilized, and barbarous," we have many stages of culture, based on the knowledge of natural forces, the utilizing of natural products by art and the co-ordination of social groups, in combinations almost as endless as the notes of an organ, the same tribe being almost civilized on one side and wholly savage on another. The classification of these grades is somewhat different in archæology and anthropology. The latter, in Lewis H. Morgan's system (which needs much qualification) marks seven stages: The first prior to the use of fire; the second marked by the discovery of fire (fire can hardly be said to have been discovered by man, as it long preceded the dawn of humanity, and its availability for warmth, and subsequently for cooking, would come about naturally, i. e., without any effort of intellectuality on man's part), and of catching fish; the third by the bow and arrow (the significance of the bow and arrow in archæology is not the same wherever this form of weapon was in use. It had an independent origin in each continental area, and whatever the starting point or prompting of the inventive faculty, the ultimate outcome would necessarily be the same. If, as persistently claimed, North America received its quota of humanity from Asia, it is certain it was at a date so early that the bow had not anywhere been invented); the fourth by pottery; the fifth by the domestication of animals, or the use of irrigation, polished stone or bronze tools, and the occurrence of adobe or stone architecture; the sixth by the use of iron; the seventh, or true civilization, by phonetic alphabets and written records. Archæology, however, finds it convenient to classify man wholly according to the material and construction of his implements, these having in fact accompanied and determined with great accuracy a corresponding set of changes in industrial arts and even social development. Accordingly it divides human progress into the Eolithic ("Stone-Dawn")

the Palæolithic or Old Stone, the Neolithic or New Stone, the Bronze and the Iron Ages; a portion of these being still further subdivided.

For vast epochs after the appearance of man upon the earth no record of his presence exists or can exist except a palæontological one — his bones. He doubtless wrenched off tree branches and threw or hammered with stones, like the higher simians, but we cannot prove a broken branch or scratches on a stone to be artificial, or due to man rather than to orang. When, however, a stone is rubbed, or evidently bruised from repeated use, still more when a number of these are found near together, we know that something more than casual use by an animal has produced the result; but it may mark only the utterly unrisen savage, who lives on nuts and fruits and sleeps under any casual tree or bank and has not thought of improving on nature.

The distinction must be kept in mind, however, between an implement and an artifact and the former is even more durable than any skeleton or part thereof; but no amount of use of a pebble as a hammer can distinguish its abraded surface from that of one in use by the latest aborigines. This is peculiarly true of quartzite pebbles, that seem to take on no appreciable patinations, that sure guide to the antiquity or lack of it, of an artifact. The first identifiable stage of real culture is:

The Eolithic Age.— This probably began (probably elsewhere also) in Kent, England, where loose flints lay about or might be easily dug from the chalk. These were very roughly hammered into an edge that would bruise off a stick or into a grip for the hand; so roughly, indeed, that their having received deliberate art at all was long bitterly contested. They are found in river deposits on the top of hills 600 feet above the present stream-beds, which must therefore have been excavated since. Even in this remote antiquity man was no new organism on the earth, and this stage of culture, from the excessive slowness of progress in the early stages, must have lasted for a long period.

The eolithic implement will always be a subject for dispute, because so like in every characteristic the unfinished implement of a more specialized type. Wherever the unmistakable polarlithic artifact is found, there will also be a still cruder object, yet distinctly artificial, which comes within the classification of "eolith." It may or may not be, under such circumstances, but such objects tell quite another story when they are found in deposits of gravel older than the latest glacial drift, and unassociated with any other trace of man's handiwork. This occurs in North America and serves the double purpose of establishing the geological antiquity of man on this continent and demonstrating the fact of an eolithic culture in Europe and presumably in Asia and Africa.

The Palæolithic Age succeeded; the former till recently was reckoned a part of it. It is now further divided into two chief periods, from the anthropological differences implied, those of the river gravels and of the cave-dwellers; and the latter again into three others, with well-marked stages of culture. More specifically:

1. River gravels up to 200 feet above present beds ("Achuleen"). The remains are massive flints scarcely less rude than the former, but unmistakably worked. They still antedate any permanent dwelling or shelter.

2. Cave-dwellers. Man now has a permanent though not artificial dwelling, and the germ of family life is born. (a) "Moustérien": Flint flakes split off (the first true artificial tool), and massive flints hammered into definite shapes, with others rude like the former. (b) "Solutrien": Flints carefully worked and finely shaped. (c) "Magdalenien": Well-shaped flint tools, plentiful bone-working with them, and drawings on implements and the walls of caves.

All these remains have been found, along with fossils of the mammoth, cave-bear, cave-lion, sabre-toothed tiger and other extinct forms, in ancient river deposits, deep under stalagmitic accumulations in caves, beneath American lava-beds, etc. The age assigned to these deposits by geologists is from 100,000 to 300,000 years. Another clue of the same significance is the circumstance that in Egypt flints are found together, of which the latest, neolithic, were dug and worked fully 7,000 years ago, and are tinged only a faint brown, while others, palæolithic, have turned nearly black. The most conservative estimate is 100,000 B.C. for the beginning of the eolithic period; the palæolithic had not ended yet, but in the advanced regions it began to be displaced by the neolithic perhaps 10,000 B.C. Roughly speaking, the Old Stone periods cover a space 10 times as long as all those since put together, the latter succeeding each other with relative swiftness, as progress accelerates by its own development. In some respects the 19th century has shown more advance than all the previous half-million years of man's existence. The rate of progress has depended greatly also on the natural advantages offered: the flint mines of the English chalk hills with the early savage perhaps corresponded to the coal and iron mines of the present, producing rapid advance in skill and also competition of tribes, the stronger expelling the weaker from the coveted districts. On the other hand, the lack of domesticable animals in America had much to do with its slight progress under barbarism.

The occurrence of a *Palæolithic Age* in North America gave rise, when first suggested, to intemperate opposition and as this was based on ignorance, the illogical position was more amusing than convincing; but the evidence of a geological antiquity steadily accumulated until now the existence of man in North America in what is accepted as the palæolithic culture is a commonplace in the world's range of knowledge.

What is included in the term *Palæolithic* is still a subject of debate. The name, as originally applied by Lubbock (Lord Avebury) to the large almond-shaped artifacts of ancient gravel deposits, has been extended until it includes more specialized forms of artifacts and, as a whole, indicates that man at that time and under those conditions was not as bestial as some groups of man, not yet, or but recently, extinct.

Our knowledge of man's career on earth, *ab initio*, is too fragmentary to speak in positive terms as to the progress any group made before its disappearance, for there is no instance of a people continuing from late tertiary

time to the present in any one locality. Occupation, abandonment and reoccupation was the rule, and hence it follows that no worked instance has been brought to light of a strictly palæolithic people gradually becoming neolithic in culture. The more specialized status replaced the less advanced, and two peoples, not one, appear in the change. That the North American Indian emerged from a palæolithic to a neolithic stage is a natural inference, as we have no geological conditions as in Europe to guide us in determining relative antiquity of this or that area and its artifacts, but so distinct are the conditions that separate one deposit of sand, gravel and clay from another, and so characteristic are the artifacts of those different deposits, it is logical to assume that one period of occupation ceased before a succeeding one began. Were we dealing with stratified rock, there would be no confusion; no question could arise, and the determination of actual conditions could, in the case of sands, be accomplished by excavations on so great a scale that demonstration could be had by virtue of numbers of artifacts found and circumstance of occurrence recorded. This has now been done and not only has the antiquity of man in North America been fully established, but the incoming and vanishing of one or more peoples occurred prior to the final possessing of the land by the historic Indian.

The Neolithic Age is the evident beginning of modern life, made possible by improved working tools. The remains of this period are not buried under geologic deposits, but lie on or near the surface. Recent finds in Florida of apparently neolithic culture have occurred at such depth and under such geological conditions as to indicate a greater antiquity of Neolithic Man in North America than had been held. They are no longer merely hammered or chipped, but rubbed or ground to shape, giving a sharper edge and a smoother surface. There is a gradual advance in the best specimens to weapons and tools almost equal to metal, such as lance heads, arrow heads, knives, daggers, awls, chisels and axes of razor-like sharpness and needle points, serviceable for and accompanied by highly developed arts and manufactures, agriculture and navigation, of remarkable magnitude and variety. As timber could now be easily cut, men built large wooden dwellings and rowing galleys. Early in the period we find immense earthworks both for defense and for burial; later, in the cities, brick architecture and fine engineering. The lake dwellings of central Europe and England belong to this period, and, being built on piles over the water, combined security against wild beast and animals with easy fishing, a fashion that spread widely and no doubt rapidly: indeed, some of them with their neolithic inhabitants lasted into historic times. From these discoveries it is evident that man not only hunted and fished, but raised grain, vines, fruit and flax, breeding domestic animals to draw the plow, another immense gain to agriculture; spun and wove; made pottery, and not only ornamented that but his tools as well, shaping them for beauty as well as use, thus showing development of æsthetic taste. Still more important was the social development. The large camps indicate a settled tribal society, the careful selection of material from considerable depths indicates combined labor in mining.

Between this and the Bronze Age there existed in some countries what is called by some archæologists a Copper Age, where native copper was hardened with oxide of arsenic; but as it did not drive out flint tools, but only supplemented them, it is hardly entitled to be called an epoch, and is not accompanied by any identifiable advance in general progress consequent upon it, like the others.

This is peculiarly true of North America, where copper was used extensively and fashioned not only into useful but ornamental shapes, but it always supplemented and never replaced the use of elaborately chipped and polished stone artifacts. It is known almost to a certainty that the Indians were well supplied with copper at the time of initial European contact, and some of it appears to have been mistaken for gold by the avaricious colonists. As metal, it was of use to the Europeans and collected wherever possible for conversion into vessels for culinary use. In this way was lost a vast amount of valuable ethnological material, which, had it been preserved, would have thrown much light on the status of the aborigine at that time.

The Bronze Age, however, was an enormous step forward. It was earlier in Assyria than Egypt, probably from the Armenian copper: the former introduced it by 5000 B.C.; the latter not fully till about 3000, and did not use it freely till 1600, only 500 years or so before iron displaced it. And in all countries stone implements were still used in sacrifices to the gods, who did not like new inventions. The hardness of the alloy of copper and tin seems to have been realized before its toughness and the many advantages given by ability to cast it; hence at first the stone tools and implements were simply copied in massive bronze, and were needlessly heavy and limited in pattern. But as its properties became evident the tools were much lightened, and made thin yet stiff with embossed patterns, and various kinds invented which could not have been made in stone, as the sickle gouge, etc. The axe, or celt, was first made as a plain bronze wedge fastened by a thong, as with stone; then cast with a socket for the helve, an extraordinary gain in efficiency. There were light cups and kettles, knives and chisels, spear- and arrowheads, swords and daggers and bronze-bound shields and a mass of personal fastenings and adornments. Some of these were impossible in stone, as buttons, buckles and pins, necklets, bracelets, rings and earrings. A priceless collection of these objects was found at Bologna, Italy, in the shape of the abandoned stock of an ancient bronze founder. The industrial advantage of this newly found hardness, toughness and variety developed industries and trade immensely; it also made possible for the first time true stone architecture and engineering of hewn and dressed stone. No small branch of business in stoneless Egypt was the quarrying and transportation of stone for the public works from the southern rockier regions.

Megolithic remains, wherever they occur, have always given rise to much speculation as to age and origin. If our present actual knowledge of such antiquities in Europe and Asia lays bare the secret of their origin and approx-

imate date of construction, the same cannot be said of somewhat similar structures in North, Central and South America. Led by resemblances, real or fancied, these examples in American forests of masonry on a gigantic scale have been held to demonstrate the "influence" of that people of another continent, whose work "appears" to have been the model for the American structure.

This is scarcely logical. Close resemblance may be accidental and the same thought may arise in minds that have no knowledge of the existence of another people than themselves. A rock-shelter or a limestone cavern may readily suggest an artificial shelter of stone and once this thought arises, the steps toward elaborate, artistic and we may add scientifically constructed buildings would inevitably follow. The engineering difficulties would be solved, if not everywhere in the same, always in a similar way, and no borrowing of ideas is called for.

As it cannot be shown that the climatic or physical conditions in the Americas was ever such that local advance was impossible among its native races, the "influence" or actual presence of a foreign people is not called for to make plain the peopling of these continents, and the checkered careers of its various nations, races, tribes or whatsoever designation may be preferred in distinguishing them.

The Iron Age is the present (though the 19th century developed what is really a distinct era, the Steel Age, making possible many advances beyond those of iron), and the most of its course belongs to history. It originated from about 1200 to 1000 B.C. — that strange period, in seeming the blackest in the calendar of the ancient world, when the old civilization of Mesopotamia had collapsed under the Semitic invaders, Egypt had sunk into decay, and barbarism seemed to have reasserted its reign over both the Eastern and Western world, yet in which lies the birth of perhaps the three greatest factors of human progress in historic times — the use of iron, the alphabet, and the Hebrew nation. The first is thought to have sprung from Armenia; regarding the second, the Phœnician origin is still valid; the third is a mysterious gift of Arabia.

Babylonia and Assyria.— The civilization of the Mesopotamian plain is not only the oldest in the world so far as known, but the first (unless with the possible exception of Egypt) where men settled in great city communities under an orderly government with a developed religion, practising agriculture by irrigation, erecting adobe buildings and using a syllabified writing. All modern Western civilization is its direct descendant through Greek and Roman periods, so that in studying it we are studying our own ultimate intellectual and even religious pedigree. Its astronomers gave us the division of the year into months, weeks and days, the signs of the zodiac, the constellations, the division of the circle into degrees; its art was the foundation on which Greek and Etruscan art was built; its religious names, forms and traditions are a deep element in the Hebrew, as in its cosmogony and mythology and such forms as the Psalms, and hence enter into Christian thought. Nor are we the only beneficiaries. For some 6,000 years the cuneiform was the business and literary script of the whole civilized world, the one method of writing from the western Mediterranean to India, and probably the origin even of the Chinese, as Mesopotamian civilization was the parent of Chinese civilization.

The physical difficulties and dangers of exploration in this district (once a garden and turned into a desert by Turkish misgovernment, a region without supplies or administrative order, and infested by hordes of dangerous Bedouins), as well as the difficulty of obtaining justice or possession of one's goods from the Turkish authorities after finding them, have kept it far behind that of Egypt in thoroughness; but the results have been not less splendid in additions to our knowledge of the past. The earliest studies — those of J. B. Rich, Indian Consul-General at Bagdad, in 1818–20, who collected sculptures and outlined Assyrian art; the excavations by the French consul, Botta, at Khorsabad in 1843, of Nimrud and Nineveh by Layard in 1845–51, and Hormuzd Rassam in 1854 — were of relatively modern Assyrian sites. The first entrance on the ancient Babylonian civilization was made at Erech (1849–52) by Loftus; a further one by Sarzac in the important Tello excavations of 1876–81; but by far the most important was by the Americans, Peters and Haynes, with Hilprecht, at Nippur from 1889 down. This was probably the first city foundation in the world, dating from about 7000 B.C., then a seaport and now 120 miles inland; and the great temple library has poured floods of light on the political and social condition of this mother-land of modern culture. Next to this, our greatest source of information — for Babylonian history almost the whole — has been the library of Nabonidus, the last king, at Babylon. The whole fabric of Assyrian chronology rests on his statement that Naram-Sin, the son of Sargon, lived 3,200 years before his time — a suspicious number, the dubiousness of which leaves half that chronology a thousand years or so doubtful. But the subject was practically sealed till the decipherment of the inscriptions gave the key; and this was immensely complicated by the fact that the cuneiform character, like the modern alphabet, did not imply any given language, but was used for all the tongues of the then civilization. The first step was taken in 1800 by Grotefend, who identified Persian names and then applied the characters to other names, till he made out several Persian inscriptions, while Bournouf (1836) and Lassen (1836–44) worked out the rest of the Persian alphabet. But this was only a small part of the enormous Assyrian syllabary of 600 signs. The task was finally accomplished by Sir Henry Rawlinson by means of the great trilingual Behistun (q.v.) inscription, in Assyrian, Median, or Vannic, and Persian; his knowledge of old Persian gained from Zend and Sanskrit enabled him to identify the Persian words in Assyrian character, and thus resolve the vast Assyrian syllabary. This has given the clue in turn to the other languages written in the cuneiform: the old Sumerian, Median, etc.

The general results are as follows: The earliest inscriptions show us a mixed people speaking two languages: one certainly Semitic, the other an archaic Semitic or Aryan (the Ural-Altaic affinity is now discredited). The non-Semitic element known as Sumerian

("river-men"?) is believed to be Aryan, related to the Caucasian tribes, and to be the original settlers of the valley. Into this valley came, somewhere between 10,000 and 8000 B.C., a Semitic invasion (Accadians = "highlanders"?) from the upper Euphrates-Tigris valleys, and by 5000 B.C. had developed, through the mixture of two powerful stocks, the wonderful civilization we know. The beginnings were in the Neolithic Age, but by 7000 B.C. the people were already organized into nations, and built fortified towns, the centre and heart of each being the temple of the local god, raised on immense piles of brickwork. They had finely colored and ornamented pottery, made with the potter's wheel. The principle of the arch was known as early as 5000 B.C.; the architecture was careful and related to the nature of material; drainage systems were constructed to prevent soaking into the adobe. Several important centres existed by about 7000 B.C., including Nippur, Ur, Eridu and probably Erech. When we first find inscriptions, perhaps about 4000 B.C., there had already been evolved from the old picture-writing a system of conventionalized line-symbols, some pure pictographs, some ideographs, some syllables; and while at first the writing was entirely votive or commemorative, and stone used as the material with straight lines, it was soon applied to business and record, the ever-present clay utilized and the lines assumed the familiar wedge or cuneiform shape. Sculpture and the engraving of gems and gold were already at a high level shortly after 4000.

The history will be found under Assyria and Babylonia. The great landmarks are the reign of Sargon, the Charlemagne of the ancient world, who founded a huge west-Asiatic "empire" from north Arabia to Armenia and west to the Mediterranean; the second great Semitic invasion from Arabia about 2500 B.C., overrunning south Babylonia, and the Elamite invasion from the Karun valley in Persia about 2300 B.C., subjugating the remainder; the expulsion of the Elamites about 2250 by Hammurabi ("Amraphel"), and the founding of Babylon, which became for 17 centuries the Rome of the Asiatic world, the political and religious centre at once; the first emergence of Assyria, on the Accadian highlands, about 1800; the Kassite invasion from the Persian highlands 1782 B.C., founding a dynasty which ruled Babylonia till 1207; their expulsion; the great double invasion of Semites from the south and Aryans from the north, which broke up the Hittite empire and overwhelmed Babylonia and Assyria in a common wreck; the collapse of the Old World civilization; the reemergence of Assyria and its domination over Babylonia, from about 900; its eclipse by the growth of Armenia in the 8th century; its new and enormous power under Tiglath-Pileser II, who annexes Babylonia; the destruction of Babylonia by Sennacherib, 689 B.C., and its rebuilding by his son Esarhaddon; the rebirth of Babylonia under Nabopolassar, the Chaldæan, who extinguished Assyria, 610 or 609 B.C., and, after a short, brilliant career, the end of the Babylonian-Assyrian power forever through its conquest by Cyrus. The relation of the Assyrian power to the Babylonian was much like that of Rome to Greece; though on a lower scale, for the Assyrians, though great warriors, had none of the organizing and assimilating power of Rome. Assyria copied laboriously, and on the whole clumsily, the literature and art of its intellectual masters, and produced no literature proper of its own. But its libraries, copied from the Babylonian tablets with minute textual and critical accuracy, give it an imperishable claim to our gratitude.

Egypt.— The archæological history of prehistoric civilizations was studied in Egypt earlier, and has been studied there more fully, than elsewhere, from the accessibility of relics and safety of work, the involution of Egyptian politics and history with records in a classic language through the existence of an Egyptian state under classic rulers, and the survival of a descendant of the Egyptian language to our own day. It was the latter which furnished the key to the decipherment of the hieroglyphic records. The Rosetta Stone (q.v.), discovered by the French in 1799, bearing a proclamation in hieroglyphic, demotic and Greek, invited a textual comparison. An Englishman, Young, devised a correct principle, but had neither knowledge nor interest to apply it in full; Sir William Gell utilized his knowledge of Coptic, and identified three-fourths of the signs; Champollion, the Frenchman, was a thorough Coptic student, and in 1821–32 worked out the entire system for use. This first made it possible to rescue Egyptian history in preclassic times from the fog of distorted Greek legends, scraps of priestly record and misapplied Biblical comparisons, while the excavations at Thebes in 1820–30 opened up the Ramesside and neighboring periods 1500–1000 B.C. Later, Lepsius and Mariette were foremost in revealing the period of the Pyramid-Builders, carrying us back to far past 3000 B.C.; and still later Dr. Flinders Petrie has not only turned the First Dynasty and others still farther back, from myth into solid history, but has recreated the prehistoric world prior to the organization of the monarchy, about 4800 B.C., with a surety as great as that of written record. In the historic periods, the total lack of any chronological sense in the Egyptians, who in this respect were very different from the Assyrians, and the catastrophe of the Hyksos invasion, make its history in large portions less clear than the Babylonian; but we know its general outline at worst, and the synchronism and variations of arts and industries often supply the lack of dated chronology.

The oldest inhabitants of upper Egypt known were of the same race as the Algerian Kabyles of to-day — a white-skinned, blond, blue-eyed, narrow-headed race, with a negro strain, allied to the south European races. They had acquired by 5000 B.C. the highest grade of Neolithic civilization ever reached in the world, so far as evidenced by tools and implements — the finish of the flint-knives and lances being incomparable — and were using copper ones also. They built brick towns and carried on an active Mediterranean commerce in large rowed galleys; they made leather and woven linen clothes, beautiful and varied pottery without the wheel, perfect vases of the hardest stone without the lathe, applied colored glazes even to great rock carvings, manufactured ornaments of precious stones, metals and ivory, ivory spoons and combs, games, etc. Their art, however, was very crude, and they had no

system of writing whatever, though using marks. About 5000 B.C. a much more developed race invaded Egypt — probably from Arabia, whence the Hyksos and the Hebrews and the other Semites came: a race which used metals more freely, had a system of writing, a better government organization and higher artistic taste. Here, as in Assyria, the blending of two able but diverse strains made the great Egyptian type and civilization of the Old Kingdom which we know from their monuments and achievements. They were a grand people in every way: active warriors and administrators, firm in policy, fine mechanicians, adepts in organizing combined labor; strong artists, with lofty conceptions; withal a sensitive, kindly, sympathetic folk, with the least strain of ferocious savagery of any great people in history. This long era has left us the pyramids and magnificent monumental tombs, masses of grand and accurate architecture and noble sculpture. This great age could not last forever, and for some centuries after about 2500 B.C. it was in decline, to revive only less brilliantly in the 12th dynasty about 2000 B.C., considered by Egyptian writers their Golden Age of art and literature. The tremendous catastrophe of the Hyksos invasion, already mentioned, took place probably about 1780 B.C., and the "Shepherd Kings" remained till about 1600. Their final expulsion opened a new and brilliant era, of expansion into and domination over west Asia, of the closest relations with the Mediterranean countries, of a general spread of luxury through the people. Egypt for the first time threw off its exclusion and became part of the current of the world's progress. In this period (about 1600–1200) we find, near the beginning, the great Thothmes III, whose exploits were exaggerated into the Sesostris of Greek tradition; near the end the rather braggart King Rameses II, commonly identified with Joseph's Pharaoh, and his son Meneptah, often accredited as the Pharaoh of the Exodus. But the empire had the doom of all states which live on the tribute of foreign districts: the outside revenue stopped, the habits of luxury remained and the nation declined. In the thousand years to follow before it was absorbed in Rome, it had much prosperity and some periods of brief glory, but the vital spirit had gone.

Syria.— While the work of the Palestine Exploration Fund, from 1866 onward, has thoroughly mapped out the surface of the country, relatively little has been done in excavation here or in Turkey; for political reasons (as before noted) mainly, as the interest in Biblical sites and classical remains is the keenest of all. The chief part thus far has been at Jerusalem and the Philistine cities, and in the north at Zinjirli; but few inscriptions have been found even where the excavation has been done, and no very ancient ones. The most important historically is that of Mesha, King of Moab (? 896 B.C.). It would seem that by the time the Jewish nation was advanced enough to make inscriptions, its intellectual activity was drawn off in other directions, and the hope of finding masses of archæological confirmation of or supplement to Biblical records has been disappointed. The chief historical result of Syrian research has been to restore the Hittites (q.v.) to history: formerly regarded as a Canaanitish tribe, they are now known to have been a powerful people from Cappadocia, which formed for a couple of centuries a strong state ruling north Syria and much of Asia Minor, with its centre at Carchemish, till broken up by the great southward Aryan movement of which the Dorian invasion was a part. Its writing is almost undeciphered. Curiously enough, the most important documents for ancient Syrian history have been found not in Syria, but in Egypt — the Tel-el-Amarna tablets, containing a 15th century correspondence with Egypt in cuneiform.

Classical Archæology.— Till the very recent excavations at Troy, Mycenæ, etc., resulting from enthusiasm for the Homeric poems, archæological research in the classic lands was mostly confined to illustrating historical periods, and to a study of Greek and Roman art and architecture; even now the light on prehistoric times is not from written records and inscriptions as in the East, but inferential from material objects. It has, however, in confirmation of Egyptian and other records, and by comparison of objects with those of known date in that country and Babylonia, given unmistakable proof of a hitherto unsuspected stratum of old Greek history. From foreign pottery found in Egypt, 5000–3000 B.C., Greece and Italy probably had a Neolithic pottery-making population at those times. But the first positive beginning of civilized settlement is in the lowest Troy, dating certainly before 2000 B.C., and perhaps 3000; almost no metal is found there. Still before 2000 is another Troy with fine vases and golden ornaments. This was contemporary with the supremacy of Crete, then the mistress of the seas, as the Etruscans and Phœnicians were later; and there was a direct connection between Crete and Troy. The legends of the great law-making Cretan kings and their suzerainty over Greece and exactions of tribute from it are doubtless based on fact; even the Labyrinth has been uncovered, and a nucleus of fact in much of the old Greek legendary lore made probable. Three times after this was Troy abandoned and rebuilt before the contemporary of the Mycenæan kingdom of about 1500 B.C. is reached. At this time the coasts of Greece and the Ægean islands were the seat of a high culture radiating in all directions, and even influencing the East, so that this has been styled the "Ægean Period" of civilization. There was a powerful and wealthy kingdom with its centre at Mycenæ, where we find magnificent domed tombs, fine jewelry and metal work, exquisite pottery and ornaments, etc., as also at other great towns marked by hill fortresses, Athens, Tiryns and other places. This rich and prosperous land traded with all the Mediterranean countries, but chiefly with Egypt, in whose ruins are found hosts of Greek objects of this period. By 1100 B.C. this civilization had begun to droop, and about 1000 the invasion of the barbarous Dorians from the north temporarily overwhelmed it on the mainland. But it was only for a time: even where the Dorians had conquered, the union of old and new flowered into richer bloom, and Athens, the chief city which they had not conquered, became the head and heart of a far more splendid revival of every art and literature, the foremost in the world to the present time. By the 7th century the immortals had begun to spring

up: Archilochus and Sappho were islanders, and the great time of Athens had not yet come, but the thronging masters show that society had become fairly settled once more.

The development of civilization was very much later in Italy than in Greece, and more slowly affected by outside civilizations except on the southern coast. The Neolithic Age, with black pottery and lake dwellings, lasted down to nearly or quite 1000 B.C., the full development of the Bronze Age not taking place till about 800. The Etruscan invasion, which tradition brings from Asia Minor, cannot be dated, but was probably later than 1000 B.C. The art and religion of the Etruscans were entirely foreign, indicating rather a Northern than an Eastern origin; but they were not an original people, and borrowed elements of civilization and art from every nation they came in contact with,—Italians, Greeks, Egyptians and Assyrians. In this assimilativeness they remind one of the Northmen, and the tradition of their origin may be wholly wrong. The one great specialty of the Etruscans was engineering. Their history and affiliations remain a mystery chiefly because their language is such. Known since historic times, and in the last century thousands of inscriptions in it copied, and even many words translated for us, the language remains an absolute secret to the laborious and penetrating scholarship directed on it.

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Revised by CHARLES CONRAD ABBOTT.

ARCHÆOLOGY, American. America's place in the world's history has been an abundant source of discussion among geologists and archæologists and there existed until recently a wide range of opinion, particularly concerning the antiquity of man on this continent. There is uniformity of opinion as to the occurence in definite superficial strata of traces of man's handiwork, but the geological history of these strata has been variously considered. It is now generally concluded, however, that they are the products of the concluding activities of various Glacial Epochs, material laid down by floods caused by the melting of the glaciers that filled the valleys and not improbably accompanied by rainfall far in excess of any in post-glacial times.

As yet the evidences of man's antiquity may be summed up in the discoveries made in the valley of the Delaware River (1872–1902) on the Atlantic slope and the shell-heap discoveries (Dall) on the Pacific slope. In the interior of the continent there have been many reported discoveries of evidences of equal antiquity, but so generally were they held to be open to possible errors of observation, due to lack of the skill required in such investigations, that their acceptance has not been general, but their claim is now more and more seen to be valid, in view of similar discoveries elsewhere, where no possible error of observation could occur. This is true even of the much-discussed Calaveras skull and Nampa image. This, however, is not true of the human cranium known as the "Lansing skull," from Kansas and the age of the deposit in which it was found only is in dispute. Much more satisfactory is the result before mentioned obtained by Dall in his investigation of the Pacific coast shell-heaps. Here we have evidence of a gradual change of habit, of a succession of occupations of the region that enables us to deal with "time relative" if not "time absolute," and to feel assured that man's first appearance on the western coast of North America was in the extremely long distant past as measured by years. As shown that traces of man occur in deposits on the Atlantic coast, notably in the valley of the Delaware River, the dual question arises just when and whence came man to the American continent? It is inherently improbable that he did so while glacial conditions obtained in the northern half of the country, for in that case he would have confined himself to those unglaciated regions in the south, where the struggle for existence was reduced to its minimum. It is far more probable that his arrival on the continent was preglacial and that when driven southward by the steady encroachment of the ice-sheet he lingered at its southward limit of extension and lived in a manner not essentially dissimilar to that of the present boreal races, but more favorable in that the fauna was richer than that of the circumpolar regions of to-day. This is not to say that the glacial man of the Delaware Valley and the Es-

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kimo of to-day were racially the same, but merely that similar physical conditions would produce essentially the same modes of living.

It can scarcely be questioned that man originally was a tropical animal, and the existence of boreal races indicates that primitive man was slowly differentiated and spreading over the earth, so far changed in habit as the environment required. Preglacial man — at least in North America — is yet to be demonstrated by unquestionable discoveries of his remains, but theoretically nothing can be more reasonable than the claim of his one-time existence. A modification of this view is that in some one of the inter-glacial periods, man may have first appeared. These inter-glacial periods were of sufficiently long duration to permit of vast changes and give ample time for a nomadic man to reach this continent or part of it from some distant point. What that point may be is still a matter of conjecture. We have many theories, but painfully few facts.

From what other continent man came to America is still an unsettled question. The necessity for an ultra-American origin is insisted upon, perhaps illogically, but, accepting the necessity, a migration route is fancied from the direction of Japan or directly across Bering Strait from Siberia and that North America was peopled by an incursion of wandering humanity into the northwest portion of the continent and thence followed down the Pacific coast and finally spread eastwardly until the Atlantic checked the movement. That the Japanese archipelago was the "home" of the first American is possible, so far as our present knowledge warrants our forming any opinion on this point; but, accepting this or another Asiatic origin of this country's "first" people, it is clearly evident, from the traces of them that have been discovered, that the trans-Pacific migration occurred in what we known as preglacial time, and so, so far in the past that race-differentiation had not progressed to an extent at all comparable to what has since occurred. The pioneer invaders of the American continent were doubtless much the same as folk wherever found at that time; in other words, still very near to that primitive condition in which man remained so long after losing all visible traces of its pithecoid ancestry. If such was his condition, man might well have wandered over a wide territory, tracing each river's valley, up or down, as the case might be, and, depending upon his physical strength and the simplest of weapons, it is little wonder that no recognizable traces of him should be found. His inventive ingenuity was subsequently developed and it is in tracing this from its humblest manifestations to the degree of skill in tool-making ultimately acquired that the archæologist is able to demonstrate that man in the lowest state of savagery originally peopled this continent and that there has been here a growth or development of human faculties which may be considered strictly indigenous. This advance toward what we call "civilization" reached its highest point in Mexico, in Central America and in Peru. That it was influenced in Mexico and Central America, if not elsewhere, by an occasional influx of Asiatic people who had outreached their distant cousins, is persistently claimed; and certainly, if at a far more remote period an Asiatic savage had reached this country, it is not improbable that such an occurrence should happen in later time, when savagery had given way to a higher cult and travel by land and water was a less formidable undertaking. Such influence may have been impressed at times upon the growing American civilization, but never to such a degree as radically to change its character. The American race was too firmly fixed to be wholly altered, and whatsoever reached it from the East in recent times — geologically speaking — made but an inconsiderable impression.

The very exhaustive study of this whole subject by the late Dr. A. H. Keane is quite sufficient to show that the Americans have always been equal to the task of producing all that exploration has shown these people did produce, and without aid or hint from peoples of other continental areas. Fortuitous resemblance has been allowed to play too great a part in ethnological speculation and the writings therefore of any author who has a preconceived idea, as notably the late O. T. Mason and other students of the historic Indian — a subject unrelated to archæology — lose much of their value. The chapter entitled Homo Americanus ('Ethnology' by A. H. Keane, chap. xiii) may be taken as the most logical and authoritative yet written. Therein, the specious pleadings of a non-American origin of all superior output of human skill is shown in its proper light of defective scholarship and lack of experience in the field, where impressions are obtained by the unbiased mind that cannot be had from specimens of stone implements displayed in museum cases.

Dating, then, the appearance of man on this continent prior to the first (Kansan) Glacial period (q.v.) and inferring that his career of differentiation from the universal or palæolithic status commenced in the first interglacial period, we find him a "stone-using animal" rather than a man as now recognized, and living such a life as that pictured by European archæologists as obtaining on that continent. Inevitably change took place as soon as the rigors of an Arctic condition (if they obtained) gave way to the temperate conditions of the inter-glacial interims; for it is now established that not one but three or four periods have occurred and so ample time is allowed for the many changes that have taken place since man's advent. The principal indications of the earliest, i.e., palæolithic man, are almond-shaped, circular and oval implements, the first mentioned distinctly pointed and all edged so sharply as to be available for cutting. While quartzite pebbles were largely used, the majority were fashioned from basalt and greatly decomposed on surface, and of argillite — slate that has been fused by volcanic heat — and these likewise are decomposed to a greater or less extent. It has been suggested that this alteration of surface was due rather to submergence in salt water, than to ordinary weathering. (Winchell.)

The intermediate periods were of indefinitely long duration and the changes incident to the first were repeated subsequently, and inferentially man witnessed them all, as he was unquestionably present at the beginning of

the Pleistocene period. During these, the surface was at first but sparsely clad with vegetation and tree growth may have been limited to coniferous forests, and even later to a deciduous forest, which was swept away by the reoccurrence of glacial conditions. At some undetermined point in time, the bow came into use and there was a faint foreshadowing of the manifold activities of later date, and possible pottery of the very rudest form, but this is doubtful. It was not until these several periods of occupation had passed and traces of them largely obliterated that the "Indian" occupation really commenced. The Indian is a man of history and of that misty borderland of history and geology known as prehistoric time. That there were interims when the "argillite" man was absent and the flint-chipping, pottery-making Indian finally appeared, has been demonstrated. It has been suggested by Hrdlicka that if the argillite man was in possession of the land when the later Indian arrived, there would be found a modification in skull type resulting from the absorption of one race by another. As yet such crania have not been discovered. This is negative evidence and it is offset by the fact that skulls have been discovered in undisturbed glacial strata that are of wholly different type from that of the Indian. How far we can be guided by craniology alone has yet to be determined, but taking in this case all conditions under consideration, in the Delaware valley, where exhaustive researches have been made (Volk), there is evidence that can scarcely be disputed that man was here to witness the closing acts of the ice-dramas — if not their entire progress — and continued to live in this river valley during the subsequent centuries that bring us to the confines of historic time. What relation he bore to the Indian who succeeded him has yet to be determined. The appearances to-day of the soil and underlying sands, each with its imperishable traces of man, suggest continuous occupation of the region, but do not prove it. In 1914, the anthropological department of the American Museum of Natural History, New York, under general direction of Dr. Clark Wissler, made a most thorough examination of the region, near Trenton, N. J., and the scene of Abbott's and Volk's labors for many years previously. The result was to confirm in every particular the conclusions reached by Abbott and Volk. (Consult 46th and 47th 'Annual Reports' of American Museum of Natural History, New York). The author of this article was present at these explorations and was firmly convinced that there was no evidence of actual contact of an earlier and later people, but the probability is strong that such contact did occur. If it did not, Hrdlicka's criticism fails in pertinence and as yet craniology has not shown that a pre-Indian might not have had the same skeletal structure as his successor. Such osteological differences might have obtained in the formative period of the human species, but not later, when race differentiation was well established. The basalt-chipper need not have been essentially different from the more skillful fabricator of chert implements. However all this may be, it does not affect the sequence here given of man's career on the Atlantic slope of North America.

A. Pleistocene Man
(pre-glacial and palæolithic in culture)
B. Inter-Glacial Man
(neolithic in culture but absense of polished stone ?)
C. Historic Indian

The so-called Indian of this continent has been so closely studied and his handiwork, whether of stone, bone, metal or clay, scrutinized so exhaustively by ethnologists that everything relating to him is familiar to all. But our knowledge is not as definite and free from contradiction as might be wished. Theories beyond count have been elaborately set forth, each claiming to fix finally the career of these people. The literature of the subject is enormous and stands quite as much a monument to our ignorance as to our erudition. That the Indian is a descendant of the man who reached the continent in pre-glacial time or during an immediately succeeding period is in all probability true. That the variations in his degree of culture and all that he has succeeded in accomplishing are due to his environment on this continent — are an unfolding of his faculties uninfluenced except by Nature — may be accepted as in all probability true of him; even such advanced outreaching toward our own conception of civilization as was found in Mexico, Central America and in Peru does not call for the incoming of a superior people. The Indian of North America, in possession when the country was invaded by the European, has been denied any significant antiquity and not a trace of his labors, whether earthwork, shell-heap or deeply-buried implement has been admitted to possess an age at all suggestive. All the "mounds" have been declared to be of Cherokee origin and not one dating so far back that the years may not be easily counted. Here the pendulum swung too far toward the craze for modernity. As well confuse the Aztec and the Eskimo. There are mounds and mounds — mounds proper, the history of which had faded from the traditions of the Indians; and earthworks that were not beyond the capabilities of the various tribal groups or tribes known to the Jesuit fathers who saw the people to such excellent advantage.

It is to the careful examination of our seacoast shell-heaps that we must look for those evidences of prolonged occupation of the country which admit practically of no dispute. These accumulations of clam and oyster shells in many localities show that they were begun when the shore level was not what it now is: the base of the heaps being now several feet below the water's surface at low tide. These shell-heaps are to be judged by the traces of handiwork found in them and likewise by a careful study of the shells themselves. The implements and pottery have been found in some instances to be of the rudest description, while in others the traces are of workmanship that was reached only in the palmiest days of Indian time. This might prove a snare to the archæologist if all considerations were not kept in view, for not a one-time village site in the land but shows a curious commingling of crude and elaborate implements, weapons and ornaments; but it has been found — on the North

Atlantic coast, at least — that shell-heaps that are apparently older are really such from the fact that argillite and basalt implements, and no pottery, are found. This significance of argillite and basalt unassociated with objects of other material has already been pointed out. But more full of meaning than all else is the fact that the same species of mollusk has gradually undergone a change during the time that elapsed between the laying down of the base of the shell-heap and the day of its final abandonment. Evolution is as slow as it is sure, and the change mentioned is alone sufficient to indicate beyond cavil the antiquity of the sea-coast dweller, who must be considered strictly post-glacial, but impressively prehistoric. An overlooked feature of the subject is that of the marked difference in the traces of man found in different village sites scattered over a limited area, as of 10 or 20 square miles. It has not infrequently happened that traces of human occupation have been brought to light wherein nothing but the rudest forms of implements and coarsest grade of pottery occur. Such have been found, too, remote from present watercourses, deeply buried, and the spot still retaining evidences of being heavily forested after the site was abandoned by man. No one can unearth such evidences of one-time human presence without being impressed with their antiquity as counted by years; but of far greater significance is the occurrence of such a village site finally abandoned, overgrown and buried by drifting sands, and then, when not a vestige of it remained visible, the spot being reoccupied by an Indian of greater skill in handicraft. Exposing the relics of the two occupations and placing them side by side, the difference is eloquent of the lapse of time beyond the skill of pen to picture.

That a family likeness should be traceable among the native races of the Americas is not remarkable and as yet there has been no sufficiency of evidence to lead us to the conclusion that the so-called "Indians" are referable to diverse origins. The cranial differences are of degree only, and when a number of skulls are brought together, the extremes are united by a series of gradations that stamp them all as one in anatomical essentials. Yet, viewing the vast territory as a whole, we find wide differences among these people, differences which may be explained, however, by the wholly dissimilar environment; this not including the strictly boreal people, though their variations from the typical Indian are not, perhaps, so great as has been asserted. The marked feature of the handiwork of Arctic man is skill in carving ivory and very strikingly etching it in such a manner that frequently the fauna of the region and mode of life of inhabitants are plainly depicted. But considering that bone and ivory take the place of stone so largely and that there is so much enforced idleness during the long Arctic winter, this artistic taste has been most naturally developed. There must of necessity be some occupation, and the artistic instinct is common to all mankind. Whether or not it flourishes — is a vigorous or a stunted growth — is, again, a matter of environment only. The comparatively few stone implements found in the far North are not noticeably well-fashioned, and the majority of their patterns are to be duplicated in the one-time Indian village sites of the temperate regions.

The purported Indian etchings on slate are not as artistic in any instance as those on ivory made within or near the Arctic circle, and it is possible that all or nearly all of them should be ruled out of court. They usually tell too much, when they pass from a series of "tally marks" or merely ornamental zigzag lines, which may or may not have had a significance beyond the fabricator's idea of decoration. The tablets from Iowan mounds and the remarkable Lenâpè stone (q.v.) from eastern Pennsylvania stand out so prominently among the Indian relics of their respective neighborhoods, and especially the latter, that an unqualified acceptance cannot be accorded them. If they were the culmination of artistic effort on the part of the Indians of the central West and Atlantic seaboard respectively, the question arises where are the pictured tablets of lesser degree of merit. There is too great a difference between the notches, straight or zigzag lines and the thrilling scene of battling with a mastodon that finally is stricken by lightning. If all this ever occurred we have no evidence that any Indian of that day had the skill to tell the story in this manner. The same is true of the Iowan tablets. That the Indian had not knowledge of the mastodon we do not claim, for there is every reason to believe that it became extinct in comparatively recent times; probably not more than 25 centuries ago. The conditions under which its bones have been found and the instances of association of human and elephantine bones show that before this country's "autochthonic hunter, Behemoth melted away."

As ethnologic importance continues to be claimed by its sole protagonist, of this "Lenâpè stone," it may be well to state that it has recently been examined by one well qualified for the task and the decision reached was that, *if genuine*, its fabricator was familiar with all the folk-lore of North America from Hudson Bay to Florida. This at once shows the object's fraudulent origin. Consult Keane, 'Ethnology,' p. 343.

What the Indian was at the time of the Columbian discovery has a distinct bearing on the archæology of the country he occupied, inasmuch as an agriculturist he was in possession of maize and grew it extensively. This plant had become during that time a product of artificially or cultivated growth, so modified that but for man's care it would have been lost. Whatever the plant from which it came there is no resemblance to it now. To effect such a change calls for an immense lapse of time. Other products of agricultural skill were as carefully grown and the impression that the results of the chase were the main food supply is not a correct one. The researches of Carr on this subject show how methodical these people were as tillers of the soil and that great suffering followed when their crops failed. The Indians did not come to America as agriculturists; of that we can be very sure, and to pass from the hunter-stage of life to that of cultivator of the ground is not conceivable as a sudden transition; but is intelligible as a slow evolutionary process. This development, in no mean stage as finally reached, shows the upward tendency of the Indians in given areas

over what is now the United States, and how much beyond the status gained they would have progressed had not European invasion checked their career is conjectural. Herbert Spencer believes they had reached the full limit of their capabilities, but among such a people as these Indians in the 15th century it is conceivable that superior intellects might appear occasionally and such men would have their following. If such men are philosophers and not fanatics, a distinct gain is the result. When it is considered that people with merely a novel view and usually an absurd one become prominent for a day and have a host of applauders, it is not unreasonable to suppose that among the Algonkins or Iroquois there might have risen those who saw the folly of war and set forth convincingly the manifold blessings of peace; who realized the advantages of agriculture over the difficulties attending hunting and so brought into existence a train of thought that would influence the people who gave them a hearing. Attracted first by the novelty of the suggestion, they would later see the logic of the argument, if such existed, and a distinct gain be made. That their growth toward our civilization would ever have been equal to our own is quite improbable, as these people have been as long upon the earth as any other race and America offers opportunities for intellectual growth equal to Asia or Europe. What does appear is that the upward growth was in existence when the blight of European contact fell upon them. Certainly the savage of 10,000 years ago was far lower in skill, in handicraft and culture generally than the men who witnessed the landing of the Norsemen. Then, or about that time, a fatal scourge seems to have raged along the Atlantic seaboard and the natives suffered a serious check, the result of which appears to have lowered their status, as smallpox and syphilis, introduced by Europeans later, largely decimated their numbers. The Indians for a time were driven to the dire necessity of daily struggle for bare existence, and many of the better things of which they were capable fell into disuse. So, at least, it seems most rational to explain the fact that these people, when European contact became permanent, were not what they had been. They had not been able wholly to recover from one disaster before another overtook them; the last, Spanish, French and English invasion, proving as destructive as fire upon the dry prairie.

The accounts of what the Jesuit fathers saw and the records of Kalm, Loskiel, Hæckewelder and many others make no mention of many forms of implements, ceremonial objects and talismans that are now familiar objects in all considerable collections of Indian antiquities; but the simpler forms, as the grooved axe, the polished celt, the arrow-head, flake-knife and pottery are not only referred to definitely, but the method of manufacture is given in considerable detail. Their hunting and agriculture are made plain, and we know with what tools they sought their game and tilled the soil, and more prominent than all else, the culture of tobacco, and the pipe in which it was burned, figure in the pages of the early travelers. Not less conspicuous as objects were more than one form of wrought stone implements to which no reference is made. It is inconceivable that they were successfully hidden, and we can only conclude that they had passed wholly out of use. Assuming that all the products of the Indian's skill in shaping stone, of which we now know nothing, were wholly in disuse and either intentionally hidden or effectually lost, it is strange that the pioneer explorers should have had so little of the archæological instinct as not to have detected traces of them.

With so great an extent of country and such diverse physical and climatic conditions, it is obvious that what were originally one people should by force of environment become widely differentiated in habits of life, and that what are now the almost tropical regions of Arizona, New Mexico and southern Colorado have been long peopled with Indians that superficially differ widely from those of the more northern regions. Their cliff dwellings, rock shelters and well-built permanent dwellings other than those on the faces of cliffs; their pottery, which they had learned to color; their weaving, basket-making and skill in stone chipping and polishing, all point to a distinct advance over the more northern nomadic tribes. It is practically demonstrated, in the judgment of those who have most exhaustively explored this southwestern region of the United States, that when the country was first occupied by the ancestors of the present Pueblo Indian, the physical conditions and climate were more favorable for human occupation than at present; a fact that has its significance, for the antiquity of man in America is one that has been long disputed; at least an antiquity at all comparable to that of man in Europe. Wandering along our Atlantic coast and laboriously picking from the accumulated shells that have almost hardened into rock, trifling potsherd, or a rude arrow point, or inland, walking over a newly-ploughed field, we gather a grooved stone axe, a celt, spear-head, arrow-point, skin-scraper or a drill; some one or two or perhaps all of these in the course of a morning, we are enabled at best to picture man in but an humble way and think of him as almost one with the wild beasts of the forest on which he preyed — an erroneous, but common impression — then, transplanted quickly to the vast southwest, note the substantial dwelling and skillful products in many lines, it is, at first, difficult to think that these people are but as branches of the same tree. The contrast is impressive and by just so much is it misleading. Step by step the gradations may be traced and when familiar with the handiwork of early man everywhere in North America, the relationship is quite apparent. The need of foreign influence to produce the differences, impressed here and there and again and again, is not apparent.

Mexico and Central America present problems that are not yet solved. Here we are brought face to face with what may be dignified as a real civilization, and so far as its genesis and continuance have been determined, it is essentially a thing of itself and points to no influences other than those that the country might exert. That a foreign element gained lodgment here and through intellectual superiority gained control over and finally absorbed a pre-occupying people has not been demonstrated. So far as we now know of it, it is not

a civilization beyond the reach of a native American race. All that is in it that resembles the culture in other continents is far more likely to be coincidence than a transplantation. That essentially the same ideas in given lines may independently arise is beyond dispute. So much more impressive is all that remains of ancient Mexican centres of population that attention has been called to the subject for more than a century and the literature of the subject is enormous, and not free of the curse of undue haste in reaching a conclusion. The Aztec has not been shown to be other than an American Indian, but one advanced beyond the "hunter stage" and so with a fixed habitation. He dwelt where his forefathers had lived and so a more rational, that is, truthful form of tradition was preserved. They were mechanics and artists. They "made useful implements and weapons and high-grade ornaments and jewels from stones, obsidian, and metal (copper, tin, lead, silver, gold); made paper and dyes and were far advanced in weaving, embroidery and feather-work." (Hrdlicka). They knew well the properties of clay and so ceramic skill was highly developed. With these accomplishments, it is not to be wondered at that they were also skilled in architecture and erected not dwellings merely, but temples on an elaborate scale and carved their surfaces in most intricate manner. The advanced artisan is always an aspirant and not satisfied, as he might well be, with the acquirements of reasonable creature comfort; in this instance of the Aztec he devised an intricate form of government and formulated a religion, polytheistic and including "the cult of the sun, moon, and stars; but with this there was a well-defined belief in a single Supreme Deity." (Hrdlicka). This Aztecan civilization was not alone in America. The Mayans of Yucatan were equally advanced as architects, as artisans and with society established on an elaborate and intricate basis. If their records have been read aright, they reach back for some 75 or more centuries, and granting this as approximating the truth, and claiming the culture existing as an indigenous growth, the date of man's appearance on the continent is carried so far into the past that we must reckon by centuries and not by years. Pure-blooded Aztecs still survive, but the glory of their culture as it blossomed in pre-conquest times is a matter of history. How great, how far comparable this civilization was to our own can be judged by the exhaustive studies of Madam Zelia Nuttall in her work, 'The Fundamental Principles of Old and New World Civilizations' (Peabody Museum Memoirs 1901). There is nothing suggestive of the "Indian" as we know him in all these pages. Astronomy, mathematics and abstruse philosophical disquisition are dealt with and we find, not unnaturally, that in striving to compass the unknowable they were led to the most extreme cruelty through that anthropomorphic idea of Deity which universally has proved a curse to mankind. The conclusion reached by Mrs. Nuttall is directly the opposite of what has been held in this article as almost if not quite demonstrable; the home, origin and growth of what has been revealed by archæological research. She writes: "I can but think that the material I have collected will also lead to a recognition that the rôle of the Phœnicians, as intermediaries of ancient civilization, was greater than has been supposed, and that it is imperative that future research be devoted to a fresh study and examination of those indications which appear to show that America must have been intermittently colonized by the intermediation of Mediterranean sea-farers."

Southward, when the adjoining continent is reached, we find in the vast plains, forests, and following the wonderful rivers of that region, savages that have not as high a standing as those of the temperate regions of North America. The struggle for existence has been, in the tropics, and is, too keen to give opportunity to a mental growth not directly concerned with the bodily passions and demands. Above all else, the savage must eat, and if the food supply is to be had without effort, the result is bodily inactivity and mental stultification. If the food required must be struggled for, then the body only is excited to vigor; and food obtained, the body is too fatigued to follow physical exertion by mental. This is the result in the extremes of tropical conditions and it is not surprising that man shows to more advantage as the climate becomes more temperate. Mind and body seem then to have more equal chance; and the same unevenness of development is found among South American Indians that originally obtained in North America. The differences are those that the different physical features of the country suggested. As Mexico stands to the country north of it, the favored spot wherein flowered and fruited the native civilization of that continent, so in Peru, we find a people who abandoned the more primitive features of a nomadic life, and establishing cities, organized government, society, gave such attention to art, agriculture and skill in varied handicraft, that they stood apart, finally, from the other peoples of South America. Compared with the advanced civilization of today it may seem crude indeed, but if we take their products of handicraft separately into consideration we shall find that they made most excellent thread and dyed it so honestly that to-day many a fabric a thousand or more years old has not lost its brilliancy of color. They were honest workmen as well as artists. It has often been asked would this culture in the interior of Peru have gone on developing had not it been snuffed out by a really as savage but more powerful a people. It cannot be determined, but as civilization is merely evolution, there is no logical reason why the potter in Peru should not finally have vitrified and glazed his wares, and the metal workers have wrought even greater wonders with the product brought to them by miners who knew their work. Peruvian products in pre-Columbian time never found a foreign market, but it is rash to say they never would have found it had they not been molested and their career destroyed for all time by the infamous invader. An antiquity of the South American native has been frequently claimed by those well qualified to express an opinion, equal to that of the North American aborigine. This is inherently probable. The indications of such antiquity are well attested, and the recent efforts of modernists of the radical type to minimize the importance of the conclusions of South American archæologists have proved an

utter failure. The antiquity of man in South America may yet be in the non-proved stage, but to date the claimants of antiquity have far the better of the question.

Whether in North, Central or South America, there were centres where things higher than mere animal wants found chance to flourish and the upward growth toward rational rather than mere physical man took place, and all about these centres roamed those outlying people, who were not degenerates, but the as yet unadvanced descendants of that original people of the early stone age to whom it fell to populate these two continents. See MOUND BUILDERS.

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Author 'The Stone Age in New Jersey'; Archæological Explorations in the Valley of the Delaware,' etc.

ARCHÆOLOGY, Christian. See CHRISTIAN ARCHÆOLOGY.

ARCHÆOPTERYX, är'kę-ŏp'tĕ-rĭks, an extinct bird exhibiting many reptilian characters, especially in having jaws provided with teeth, and a long tail of many vertebræ; and it constitutes a link between birds and reptiles. It lived during the Jurassic period and is by far the most ancient bird known. Its distinctness from all other birds is expressed by placing it by itself in a separate sub-class; the Archæornithes birds are the rarest of fossils, and this one is known only from two skeletons and a single feather, all preserved in the lithographic limestone quarries of Solenhofen, Bavaria. The skeletons, one in the British, the other in the Berlin Museum, are wonderfully well preserved in the fine, smooth-grained stone and have the impressions of the feathers in their natural position. They show that the Archæopteryx had short wings with primary and secondary feathers arranged much as in modern birds; but the bones of the wing are not so specialized for their peculiar use as in modern birds; the metacarpal bones are separate and the digits free and complete, each with a claw on its tip, while in modern birds the first and third digits are rudimentary and the metacarpals fused into a single bone. The long tail of 23 separate vertebræ has the feathers arranged in pairs springing from the sides of each vertebra except toward the tip; in modern birds the tail-feathers spring from a triangular bony plate at the end of the short rudimentary tails. (See BIRDS). The teeth are like those of many lizards, sharp, conical, each set in a separate socket, and there is no horny bill as in modern birds.

The extinct Dinosaurs are the reptiles which come nearest to Archæopteryx, and it is probable that they are descended from a common stock, the ancestors of the birds becoming arboreal and acquiring rudimentary wings to assist them in leaping from tree to tree. A somewhat analogous case is seen in the fold of skin and hair which the modern flying squirrels

have developed for the same purpose; if further developed and specialized this would enable them to accomplish true flight. In Archæopteryx the wings are short and the attachments for the breast muscles (those chiefly used in flight) are small in comparison with those of modern birds, so that the creature must have had very limited powers in this direction.

ARCHÆORINTHES, one of the two subclasses of birds, including only *Archæopteryx* (q.v.). The other sub-class, *Neornithes,* includes all the remainder, either fossil or living.

ARCHÆOZOIC. See ARCHEAN.

ARCHAMBEAULT, Sir Horace, Canadian priest: b. L'Assomption, Quebec province, 6 March 1857. He was educated at L'Assomption College and Laval University, Montreal, where he was graduated Master of Laws in 1878 and was afterward (1881) professor of commercial and maritime law. Appointed to the legislative council of Quebec in 1888, he was speaker of that body and Attorney-General (1897–1905). In 1890 he became a member of the Council of Public Instruction. He was appointed a puisne judge of the Court of King's Bench of Quebec in 1908, and Chief Justice in 1911. He was knighted in 1914.

ARCHANGEL, an angel of superior or of the highest rank. They are seven in number, of which Michael, Gabriel and Raphael are mentioned in Scripture.

ARCHANGEL, ärk-ān'jĕl, seaport, capital of the Russian government of same name, on the right bank of the northern Dwina, about 20 miles above its mouth in the White Sea. The port is closed for six months by ice. Archangel, founded in 1584, was long the only port which Russia possessed. Pop. 21,930. The province contains 331,490 square miles; pop. 348,500.

ARCHBALD, Pa., borough in Lackawanna County, 10 miles northeast of Scranton, on the Delaware & Hudson and the New York, Ontario & Western railroads. It was first settled by Welsh miners in 1831 and is to-day essentially a mining town. It has many churches and schools and several imposing public buildings. Silk mills give employment to 350 persons, while over 3,500 men and boys are employed in coal mining. Pop. (1910) 7,194.

ARCHBISHOP. The name of a chief bishop. The attentive reader of the Acts of the Apostles, noting that nearly the whole missionary energy of Saint Paul was expended upon the cities and chief towns rather than on the villages and the country districts, will be prepared to learn that there were flourishing churches in the leading centres of population, while, as yet, nearly all other parts remained pagan. So strong, however, was the evangelistic spirit prevailing that a number of younger and less powerful congregations were called into being. The pastors of these new churches being called bishops, that term no longer appeared a dignified enough appellation for the spiritual chief of the mother church, and about A.D. 340 the Greek title of *archiepiscopos* was introduced.

An archbishop is often called a metropolitan. He exercises a certain supervision over the bishops of his province, who are called his suffragans; convenes and presides over them in provincial councils, receives appeals against their decisions in matters of discipline and, in the event of the death of one of them, provides for the administration of the diocese. In the United States the Roman Catholic Church is the only one which has dignitaries of this rank, and in 1900 the entire country comprised 14 archdioceses, Baltimore, as the first established see, having the dignity of primacy.

In England the early British churches were, in large measure, swept away by the Anglo-Saxon invaders, who were heathens, and the country consequently required to be reconverted. The great southern centre from which this was done was Canterbury, then the capital of Kent, where King Egbert gave Augustine, the chief missionary, a settlement. In the north, York, the chief town of Northumbria, where King Edwin built a shrine for Paulinus, became the great focus of operation for that part of England; hence the two archbishoprics now existing are those of Canterbury and of York. The prelate who occupies the former see is Primate of all England, while his brother of York is only Primate of England, the superiority of the see of Canterbury, long contested by that of York, having been formally settled in A.D. 1072. The former is the first in dignity after the princes of the blood; the latter is not second, but third, the Lord Chancellor taking precedence of him in official rank. In Ireland the same distinction holds for Armagh and Dublin. When the Catholic hierarchy was established in England in 1850 Westminster was constituted the metropolitan see.

ARCHBOLD, John Dustin, American oil magnate: b. Leesburg, Ohio, 26 June 1848; d. Tarrytown, N. Y., 6 Dec. 1916. After attending the public schools at Leesburg Mr. Archbold became a clerk in a country store at Salem, Ohio. He remained there for two years and in 1864 went to the Pennsylvania oil regions, where for 11 years he was actively identified with various branches of the industry in Oil City, Pa. He became chief owner and president of the Acme Oil Company and in 1875 director of the Standard Oil Company. Of the first nine trustees of the Standard Oil "Trust" formed in 1882, Mr. Archbold alone remained in that capacity until its dissolution in 1911, by the order of the United States Supreme Court, after which he became president and director of the Standard Oil Company of New Jersey. He was an intimate associate of John D. Rockefeller; active in philanthropic associations and president of the board of trustees of Syracuse University, to which institution he gave large endowments. His fortune at the time of his death was estimated at $100,000,000.

ARCHDALE, ärch-dāl, **John,** American colonial governor: b. Buckinghamshire, England, probably about 1635. Ferdinando Gorges, the last proprietor of Maine, married his sister Mary in 1660, and in 1664 sent him to Maine to set up Gorges government afresh in opposition to Massachusetts, under whose protection the settlements there had placed themselves. (See GORGES). They resisted Archdale so fiercely that the next year he sailed for home, entirely baffled. In May 1681 he acquired a dubious title to a share in the proprietorship of the Carolinas, and in 1682 the proprietors

commissioned him to come over and receive their rents from "Albemarle" (North Carolina). He was there by 1683, with the intention of settling permanently (as his daughter did) — perhaps drawn by a liking for the Quakers in the colony, he having been converted by George Fox. A few years later, however, he returned to England, and was one of the chief managers of the proprietary affairs. In 1688 he appears on depositions in the Gorges matter, private claims being still unsettled; but there is no evidence that he visited Maine again. In 1694, the Carolina proprietors needing some manager on the spot he was induced to become governor of South and North Carolina by the title of "landgrave" and the attendant barony of 48,000 acres; but it was not till 17 Aug. 1695 that he assumed the government at Charleston, and he retained it but a year, then turning it over to a deputy and returning to England again. The complimentary address of the assembly on his departure has been taken literally as a proof of influential and pregnant statesmanship; but in fact he dissolved his first assembly in haste from a quarrel over abatement of quit-rents, compromised with the second, left the Huguenots unenfranchised and the unsatisfactory Indian trade as it was and made no strong impress. His spirit was good, however: he treated the Indians with humanity and modified some hard restrictions on them; drew up a militia act (into which the assembly unanimously refused to put a clause exempting the Quakers), and established a bureau of public charities.

He is also credited with having introduced rice culture into the Carolinas, through a bag of rice which a merchant vessel brought from Madagascar and he distributed among his friends.

In 1698, elected a member of Parliament, he refused to take the oath; would only affirm, and was not permitted to take his seat. In 1707 appeared 'A New Description of that Fertile and Pleasant Province of Carolina,' by him, a vindication of his administration, of little value except for some original documents.

ARCHDEACON, an ecclesiastical dignitary next in rank below a bishop, who has jurisdiction either over a part of or over the whole diocese. He is usually appointed by the bishop, under whom he performs various duties, and he holds a court which decides cases subject to an appeal to the bishop. The dignity is still maintained in the Anglican but not in the Roman Catholic Church, the canons or rural deans exercising the same functions as archdeacons.

ARCHDUKE, a duke whose authority and power is superior to that of other dukes, a title in the present day assumed only by the princes of the imperial house of Austria. In France, in the reign of Dagobert, there was an Archduke of Austrasia; and at a later period, the governors of provinces of Brabant and Lorraine were termed archdukes. The dukes of Austria assumed the title of archduke in 1156; but the dignity was not confirmed till 1453.

ARCHEAN, a geologic time unit usually given the rank of a period, and the system of rocks laid down during that period. It is the earliest division of the Proterozoic Era. This time unit is sometimes given the rank of an era under the name of Archeozoic. The rocks of the system are well exposed in the Lake Superior region, though rocks believed to be of equivalent age are exposed in the Piedmont Belt, in the Ozarks, at many points in the Rocky Mountains, over much of Canada and northern Europe and at places in other continents. The rocks are dominantly igneous, consisting of thick lava flows interbedded with minor amounts of sediment (the Keewatin) and cut by great batholiths (q.v.) of granite (the Laurentian). They contain the iron ores of the Vermilion Range (q.v.) in Minnesota. No direct evidences of life have been found in Archean rocks. Of the climate or geography of the period practically nothing is known.

ARCHEGONIUM, the female organ of mosses, liverworts, ferns, conifers, etc. It is usually flask-shaped with a neck of varying length and a venter more or less bulbous. A single egg reposes in the venter, and in the process of fertilization the sperm enters by the neck and reaches the egg. The archegonia are variously placed in the bryophytes, pteridophytes and the gymnosperms. The neck cells secrete a substance which attracts their own particular sperms toward them.

ARCHEGOSAURUS, är'kẹ-gō-sō'rŭs, a fossil saurian reptile, found in 1847, in large concretionary measures of clay-ironstone, from the coal field of Saarbrück. Four species have been described. Professor Owen makes it a connecting link between the reptile and the fish, and on these grounds: it is related to the salamandroid-ganoid fishes by the conformity of pattern in the plates of the external cranial skeleton, and by the persistence of the chorda dorsalis, as in the sturgeon, while it is allied to the reptiles by the persistence of the chorda dorsalis, and the branchial arches, and by the absence of the occipital condyle or condyles, as in Lepidosiren, and by the presence of labyrinthic teeth, as in Labyrinthodon, which, however, also ally it to the ganoid Lepidosteus. See STEGOCELPHALIA.

ARCHELAUS, är'kẹ-lā-ŭs, the name of several personages in ancient history, of whom we need mention only Archelaus, the son of Herod the Great. This prince received from Augustus, with the title of Ethnarch, the sovereignty of Judea, Samaria and Idumea. His reign is described as most tyrannical and bloody. The people at length accused him before Augustus, who, after hearing his defense, banished him in A.D. 10 to Vienne, in Gaul, where he died. To avoid the fury of Archelaus, Joseph and Mary, with the infant Jesus, retired to Nazareth.

ARCHENHOLZ, är'HEn-hōlts, **Johann Wilhelm von,** German historian: b. 5 Sept. 1743; d. 28 Feb. 1812. He took part in the closing campaigns of the Seven Years' War and retired as captain, 1763; traveled extensively in Europe, lived in England the greater part of 1769–79, and settled in Hamburg in 1792. His book on 'England and Italy' (1785), extensively translated, obtained a phenomenal success. A sequel to it was 'Annals of British History' (1789–98, 20 vols.). His 'History of the Seven Years' War' (1789; augmented 1893, 13th ed. 1892) is still the most popular account of that war.

ARCHEOZOIC. See ARCHEAN.

ARCHER, Branch T., Texan revolutionist: b. Virginia 1790; d. Texas, 22 Sept. 1856. He studied medicine in Philadelphia, practised many years in Virginia and was repeatedly a member of the legislature. In 1831 he removed to Texas, and was one of the leaders in preparing for the revolution determined upon far in advance of the actual crisis. On 3 Nov. 1835 he presided over the celebrated "consultation" of the American settlers concerning independence, and immediately after was one of three commissioners — the others being Stephen Austin and N. H. Wharton — to solicit aid from the United States. The next year he became speaker of the House in the first Texan Congress; and he was Secretary of War for Texas 1839–42, when bodily infirmity compelled him to retire from public life.

ARCHER, Frederic, organist and musical director: b. Oxford, England, 1838; d. Pittsburgh, Pa., 1901. Educated at Oxford, London and Leipzig, and held important positions as organist in Oxford, London and Glasgow, 1852–79. Organist Plymouth Church, Brooklyn, N. Y., 1880–85; conductor Boston Oratorio Society, 1887; founded Pittsburgh Symphony Orchestra, 1896; organist Church of the Ascension, Pittsburgh, 1899–1901. He gave recitals and lectured on musical subjects throughout the United States and Canada. Founded and edited *The Keynote* (1885).

ARCHER, John, American physician: b. Harford County, Md., 6 June 1741; d. there 1810. He was graduated at Princeton, 1760, and in 1768 received from the Philadelphia Medical College the first medical diploma issued in America. He raised and commanded a military company during the Revolution, served several years in State legislature, was a presidential elector in 1801, and member of Congress 1801–07. He made several discoveries in medicine which have been adopted by the profession.

ARCHER, William, English author and critic: b. Perth, Scotland, 23 Sept. 1856. Educated at Edinburgh University; became barrister, Middle Temple, 1883. Went to London 1878, became dramatic critic of the *Figaro,* 1879–81, and London *World,* 1884–1905, afterwards of the *Tribune* and *Nation,* now of the *Star.* He has edited and translated Ibsen's 'Prose Dramas' (5 vols.) and with his brother translated Ibsen's 'Peer Gynt.' He has written 'Life of Macready' (1890); 'English Dramatists of To-day' (1882); 'The Theatrical World' (5 vols., 1893–97); 'Study and Stage' (1899); 'America To-day' (1900); 'Poets of the Younger Generation' (1901); 'Masks or Faces: a Study in the Psychology of Acting'; 'Real Conversations' (1904); 'Through Afro-America' (1910); 'Play-making' (1912); 'Life, Trial and Death of Francisco Ferrer' (1912); 'The Great Analysis' (1913).

ARCHER-FISH, a fish reputed to be able to shoot drops of water from its mouth at insects in the air above, thus bringing the insects down where they can be seized. The name is most frequently applied to a single species, *Toxotes jaculator,* a fish six or seven inches long, a native of Java and the neighboring islands, which represents an aberrant group of chætodonts, or coral fishes (q.v.). This, however, is an error of identification, the true fish with this habit being a related small coral fish (*Chelmon rostratus*) of India. This genus has its mouth extended into a tube-like snout, forming a sort of nozzle. When it perceives an insect perched on a plant over the water, it swims to within a distance of from four to six feet, and then with surprising dexterity will eject a single drop of water with so true an aim as to knock the insect into the water where it is instantly seized. Captives will do this in a tank or aquarium; whereas experiments show that the Toxotes never does such a thing for which its mouth is entirely unfitted.

ARCHERY. Ages after the bow and arrow had disappeared in general use from Europe and many other countries, it was the universal arm both for war and sport in the Americas, from Patagonia to the Arctic Circle, and its use lingered on the borders of advancing civilization till within the memory of thousands living. It may indeed be considered the most characteristic American weapon, yet the practice of archery as a recreation is limited. A few societies of Toxophilites exist and hold monthly meetings and annual contests. The principal clubs are in the neighborhood of Washington, D. C., and of Cincinnati.

A faithful band, too, of whom the late Maurice Thompson, author of 'Alice of Old Vincennes,' was the exponent, have continued into this 20th century to take the bow and arrow into field and forest, and to live while in camp by the product of their skill in its use. Several charming pen pictures may be found in the pages of *Scribner's, Harper's, Outing* and the *Badminton* magazines, relating their hunts after turkeys, herons, wild duck, woodduck and squirrels, and even fish, in Florida, Georgia, Illinois, Indiana and other States. For practical purposes, however, the attention may be confined to archery as popularly understood: that is, shooting at the target as a recreation and to acquire skill. This form of its use continued long after gunpowder had become common: in fact the first book of instruction in archery, that of Roger Ascham, the teacher of Lady Jane Grey, and professor of Greek at Cambridge, 'Toxophilus or the Schole of Shooting,' was published in 1571, when the bow had practically become obsolete as a weapon of offense. The bow used for recreation is the long-bow and not the arbalest or cross-bow which was used by William Tell. That style of the bow was never popular in England. As gunpowder came more and more into use in sports, the interest in the bow and arrow faded. About the year 1760 the possibilities of archery as a builder up of the body and the eye-sight were rediscovered, and from thenceforward it had a lusty growth and has always had a considerable following of devotees both in England and America. Bows are made either of one piece of wood, or two or more strips glued together, preferably of yew. A man's bow is about six feet in length, and a woman's some half a foot shorter. A man's bow requires a pull of from 40 to 50 pounds, a woman's about half that amount. The distance shot varies with the kind of contest. A Potomac round consists of 24 arrows at 80 yards, 24 at 70 and 24 at 60; a double Columbia round of 48 arrows at 50 yards, and 48 at 40. A double York round of 144 arrows

at 100 yards, 96 at 80 and 48 at 60. A double National round of 96 arrows at 60 yards and 48 at 50, and a double American round of 60 arrows at 60 yards, 60 at 50 and 60 at 40. The arrow's shape and feathering is a matter of personal inclination. The targets are four feet in diameter, made of banded straw with a canvas front painted in five concentric rings, the centre gold, then red, blue, black and white; the value in counting shots being, respectively, 9, 7, 5, 3 and 1. There are in the National meet also competitions for longest flight and annual team competitions of 96 arrows at 60 yards for men and 96 arrows at 50 yards for women. Consult Ascham, Roger, 'Toxophilus, or the Schole of Shooting' (London 1868); Hansard, G. A., 'The Book of Archery' (ib. 1840); Morse, E. S., 'Archery, Ancient and Modern' (Worcester, Mass., 1792); Thompson, Maurice, 'The Witchery of Archery' (New York 1878); Roberts, T., 'The English Bowman' (London 1801); Waring, T., 'A Treatise on Archery' (ib. 1828).

ARCHES COURT, the chief and most ancient consistory court, belonging to the archbishopric of Canterbury, for the debating of spiritual causes. It is named from the church in London, Saint Mary le Bow, or Bow Church (so-called from a fine arched crypt), where it was formerly held.

ARCHIBALD, Sir **Adams George,** Canadian statesman: b. Truro, Nova Scotia, 18 May 1814; d. Halifax, 14 Dec. 1892. He was secretary of state for the provinces in the Dominion government, 1867-68; lieutenant-governor of Manitoba and the Northwest Territories, 1870–72; and held the same office in Nova Scotia, 1873–83. He was created K. C. M. G. in 1885.

ARCHIDAMUS, är'kĭ-dā'mŭs, the name of several kings of Sparta. I. The son of Anaxidamus, who lived during the Tegeatan War, which broke out soon after the termination of the second Messenian War, in the year 668 B.C. II. The son of Zeuxidamus, who succeeded to the throne in the year 469 B.C. In the fifth year of his reign there was an earthquake in Laconia which almost destroyed Sparta. In that trying period the foresight of Archidamus probably saved the surviving citizens from being massacred by the Helots. In the discussions at Sparta and Corinth, which preceded the rupture with Athens, he acted a prominent part, and always as the advocate of peace and moderation. He survived the outbreak of the Peloponnesian War about five years, during which time he had the conduct of three expeditions against Attica and one against Platæa. Archidamus died in the 42d year of his reign, 427 B.C. III. Son of Agesilaus II. While yet a boy he prevailed on his father to pardon Sphodrias, who had dared to make an irruption into Attica at a time of profound peace. In 371 B.C. he was sent to the relief of his countrymen who had been vanished at Leuctra. In 367 B.C. he defeated the Arcadians and Argives in what the Spartans termed the "scarless battle," because they had won it without the loss of a single man. Archidamus III appears to have been a warlike prince, but he was neither a great general nor a great statesman, and makes but a poor figure in either capacity after such kings as his father and grandfather. IV. Son of Eudamidas I and grandson of Archidamus III, was King of Sparta in 296 B.C. V. Son of Eudamidas II. Archidamus V was the last king of the Eurypontid race that reigned in Sparta. When he was killed the rights of his children were disregarded and his crown was given to a stranger.

ARCHIL, är'kĭl, or **ORCHIL,** ôr'kĭl, a coloring matter obtained from various kinds of lichens, the most important of which are the *Roccella tinctoria* and the *R. fuciformis.* The *Lecanora tartarea,* or cudbear, is another of the same nature; orchella-weed and dyer's-moss are common names for them. The *R. tinctoria,* or archil plant proper, is abundant in the Canaries and Cape Verde Islands, and in the Levant; the *R. fuciformis* also grows chiefly in warm climates, as the coasts of Africa (Angola) and Madagascar. The lichens, which are chiefly collected from rocks near the sea, are cleaned and ground into a pulp with water, after which some ammoniacal liquor is added, when the coloring matter, red, violet or purple, is evolved and falls to the bottom. The red coloring matter of *Lecanora tartarea* produces litmus when lime or an alkali is added. Archil has a beautiful violet color. It is used for improving the tints of other dyes, as from its want of permanence it cannot be used alone.

ARCHILOCHUS, är-kĭl'ō-kŭs, a Greek poet, classed by Cicero with Homer and Sophocles: b. in the Island of Paros, flourished between 720 and 660 B.C. While a resident of Thasos, he incurred disgrace by throwing away his shield in a battle. He was the inventor of iambics. His terrible invective is said to have caused several suicides. A hymn to Hercules was the most esteemed of his poems, and used to be sung three times in honor of the victors at the games.

ARCHIMANDRITE, är'kĭ-măn'drīt, in the Greek Church, an abbot or abbot-general, who has the superintendence of many abbots and convents.

ARCHIMEDES, är'kĭ-mē'dēz, one of the most celebrated among the ancient physicists and geometricians: b. Syracuse about 287 B.C. Though, according to some accounts, a relation and certainly a friend of King Hiero, he appears to have borne no public office, but to have devoted himself entirely to science. We cannot fully estimate his services to mathematics for want of an acquaintance with the previous state of science; still we know that he enriched it with discoveries of the highest importance, upon which the moderns have founded their admeasurements of curvilinear surfaces and solids. Euclid, in his 'Elements,' considers only the relation of some of these magnitudes to each other, but does not compare them with surfaces and solids bounded by straight lines. Archimedes has developed the propositions necessary for effecting this comparison in his treatises on the sphere and cylinder, the spheroid and conoid, and in his work on the measure of the circle. He rose to still more abstruse considerations in his treatise on the spiral, which, however, even those acquainted with the subjects can with difficulty comprehend. Archimedes is the only one among the ancients who has left us anything satisfactory on the theory of mechanics, and

on hydrostatics. He first taught the principle "that a body immersed in a fluid loses as much in weight as the weight of an equal volume of the fluid," and determined, by means of it, that an artist had fraudulently added too much alloy to a crown which King Hiero had ordered to be made of pure gold. He discovered the solution of this problem while bathing; and it is said to have caused him so much joy, that he hastened home from the bath undressed, and crying out, .Eureka! Eureka! "I have found it; I have found it!" Practical mechanics, also, received a great deal of attention from Archimedes. He is the inventor of the compound pulley, probably of the endless screw, etc. During the siege of Syracuse he devoted all his talents to the defense of his native country. Polybius, Livy and Plutarch speak in detail with admiration, and probably with exaggeration, of the machines with which he repelled the attacks of the Romans. They make no mention of his having set on fire the enemy's fleet by burning-glasses,—a thing which is in itself very improbable, and related only in the later writings of Galen and Lucian. At the moment when the Romans, under Marcellus, gained possession of the city by assault, tradition relates that Archimedes was sitting in the market-place absorbed in thought, and contemplating some figures which he had drawn in the sand. To a Roman soldier who addressed him, he is related to have cried out, "Disturb not my circle!" but the rough warrior little heeded his request, and struck him down. The conquest of Syracuse is placed in the year 212 B.C. On his tombstone was placed a cylinder, with a sphere inscribed in it, thereby to immortalize his discovery of their mutual relation, on which he set particular value. Cicero, who was appointed quæstor over Sicily, found this monument in a thicket which concealed it. Of the works of Archimedes there are extant a treatise on 'Equiponderants and Centres of Gravity,' in which the theory of the lever and other mechanical problems are treated; on the 'Quadrature of the Parabola'; on the 'Sphere and Cylinder'; on the 'Dimensions of the Circle'; on 'Spirals'; on 'Conoids and Spheroids'; the 'Arenarius,' a speculative treatise intended to refute the popular notion that the number of grains of sand on the seashore is infinite by showing that a definite number might be assigned to a quantity of grains sufficient to fill the sphere of the fixed stars, remarkable as containing an anticipation of the modern discovery of logarithms; on 'Floating Bodies'; a treatise called 'Lemmata,' of doubtful authenticity, on plane geometry. A very complete and splendid edition of the works of Archimedes issued from the Clarendon Press, at Oxford, in 1792. Other editions appeared in 1881 and 1897.

ARCHIMEDES, Principle of. See ARCHIMEDES.

ARCHIMEDES' SCREW, a machine invented by Archimedes while studying in Egypt. Observing the difficulty of raising water from the Nile he is said to have designed this screw as a means of overcoming the obstacle. It consists of a pipe twisted in a spiral form around a cylinder, which, when at work, is supported in an inclined position. The lower end of the pipe is immersed in water, and when the cylinder is made to revolve on its own axis, the water is raised from bend to bend in the spiral pipe until it flows out at the top. The Archimedian screw is still used in Holland for raising water and draining low grounds. The Dutch water-screws are mostly of large size, and are moved by the wind, one windmill furnishing sufficient motive power to keep several screws going at once.

ARCHIPELAGO, ärˈkĭ-pĕlˈą-gō, a term originally applied to the Ægean, the sea lying between Greece and Asia Minor, then to the numerous islands situated therein and latterly to any cluster of islands. In the Grecian Archipelago the islands nearest the European coast lie together almost in a circle, and for this reason are called the Cyclades (Gr. *kyklos,* a circle); those nearest the Asiatic, being farther from one another, the Sporades ("scattered"). (See these articles, and CYPRUS; EUBŒA; RHODES; SAMOS; SCIO, etc.). The Malay, Indian or Eastern Archipelago, on the east of Asia, includes Borneo, Sumatra and other large islands. See MALAY ARCHIPELAGO.

ARCHITECTURE. Architecture is the art of building wisely and, as the embodied philosophy of man's community ideals, is the complete index of the civilization of each age. Beauty in architecture involves such a disposition of the structural elements demanded by a problem as will give to each a maximum value in the given situation. The development, growth, and change that characterize architectural expression in different climates, countries, and ages determine historic styles. No style is the result of chance, but is always the concrete representation of the humanities, a reflection of intellectual, social, religious, military, and political conditions. Architectural styles are identified by the means employed to cover enclosed spaces; first, by the characteristic forms of the supports; and secondly, by the decorative embellishment of the elements of the structural form.

Prehistoric Monuments.— Geographically and chronologically, the earliest construction forms are the Lake Dwellings which have been discovered at the bottom of some of the Swiss lakes. These lake dwellings were very primitive houses or huts erected on piles. These hut villages were built over the water for protection. They were known to writers of antiquity, and Assyrian reliefs picture them. They date back to the Paleolithic Age. More important from the standpoint of architecture are the Megalithic remains of Europe and Asia. They are widely distributed and probably were erected as religious or funerary monuments. Upright stones without lintels are called Menhirs; tomb chambers consisting of upright stones carrying a lintel are termed Dolmens. The circles of stones, the Cromlechs, the most famous of which is at Stonehenge, near Salisbury, in England, has a religious significance. While it is true that the earliest human works known, found in the caves of the provinces of Dordogne, France, and Santander, Spain, show various decorative treatments, no evidences of structural art appear. There is every reason to believe that the state of civilization marked by these finds in the caves of Western Europe typify an era of the Stone Age, during which the South of Europe was populated. This being true, it is possible to establish as an approximate

date for the inception of prehistoric styles, a date of 25,000 or 30,000 years before Christ.

Egypt.— The Valley of the Nile was peopled as long ago as 7000 B.C. with a race highly skilled in prehistoric arts. Dr. Petrie's discoveries between Nagada and Ballos have shown that a flint working people in the Paleolithic era dwelt in this region. Their technique, judged from the knives and bracelets that have been found, was more advanced than in any other country where relics of the stone age have been exhumed. These finds characterize an art that must have been developed over a vast series of years, and the remarkable skill in manipulating stone exhibited in the Pyramids and structures of the dynastic periods is directly traceable to these Stone Age ancestors. The works, major and minor, of the historic Egyptians from the time of the ancient Empire through the Roman period are characterized by a lavish use of color. The presence of this chromatic element indicates the persistent influence of a race whose art was developed out of the clay industries, for the evolution of the pottery art brought into use, necessarily, constant and various methods of color decoration. The question as to the origin of this color influence is satisfactorily answered by the examination of the development of the arts of Mesopotamia. The absence of the color feature before the time of the early Memphitic dynasties and its lavish use subsequent to that time indicates that the historic Egyptians combined a Nilo-Prehistoric and a Mesopotamian race, and the art of the Valley of the Nile, hitherto considered simple and elemental, is in reality a composite of earlier totally opposite origins. A general survey of the entire field of Egyptian architecture develops five notable characteristics. First, the colossal character of the monuments; second, the evolution of the proto-Doric and the proto-Corinthian columns and capitals; third, the development of the clerestory and its effect upon the problems of scale and ornament; fourth, the Egyptian temple, containing as it does the elements of the Greek temple and the later Christian Basilica, from which was subsequently developed the form of the Romanesque churches and Gothic cathedrals; fifth, architectural refinements, by which certain optical illusions were counteracted and vigor of aspect was added to the monuments. Five distinct periods marked the history of Egyptian architecture. The ancient empire is characterized by sepulchral works and includes the most ancient monumental buildings of which we have any remains. The period is terminated by the 10th dynasty, 3000 B.C., and the centre of the constructive activity was Memphis. The most typical works of the era, the Pyramids, number over a hundred, and in six groups extended from Abu Rôash in the north to Mêdum in the south. They were all tombs, and housing the requirements of the religious ideal of the Egyptians contained a sepulchral chamber, together with a dependency votive chapel built separate from but adjacent to the pyramid. As the cardinal point in the religious doctrine of the Egyptians was the belief in a future state of existence,— that at some distant time the body would be revivified,— so every effort was directed to the preservation of the embalmed body to insure the comfort of the soul. The stupendous pyramids and numerous mastabas and rock-cut tombs were lavishly decorated with scenes depicting surroundings and conditions of the life of the deceased. Each fresco wall is a page from the history of the civilization that flourished 5000 years ago. The Gizeh group, three in number, presents the most perfect type of pyramid construction. The works of the Middle Empire (3000 to 2100 B.C.) were almost entirely sepulchral in character, although the rock-cut tombs hewn in the limestone cliffs at Beni-Hassan for the great vassal princes of the 11th and 12th dynasties furnish, in their disposition and decoration, an indestructible record of the domestic habitations of the period. Likewise they register the experimentations in the civil architecture of the age. The first evidences of temple architecture that occur in Egyptian history belong to this middle period, dating probably from the 12th dynasty, about 2000 B.C. From these remains, both at Bubastis and Karnak, it is certain that structural stone columns as well as monolithic stone columns were used as elements of Egyptian architecture. It can be definitely assumed that the philosophy of the whole architectural system of the new empire, and subsequently of the historic columnar eras in Europe, had their origins in the age of the Middle Empire. There was an interruption in the current of Egyptian art history for some five centuries following the fall of the Middle Empire. The re-establishment of the Theban supremacy in the 18th dynasty marked the inception of an extraordinary series of religious and funerary monuments. In the development of these structures the column formed an important part. This period, comprising the 18th to the 20th dynasties, 1700–1000 B.C., was characterized by the great temple constructions at Karnak, Luxor, and a magnificent series of tombs, some of which were structural and others excavated, the most magnificent of which were those of Queen Hatasu at Deir-El-Bahari and that of Rameses II and Rameses III, erected on the west bank of the Nile opposite Thebes. During this period columnar architecture was magnified to an extraordinary scale and the planning of the tremendous temple halls, the roofs of which were upheld by numerous massive columns, brought to the designer a new problem, the solution of which was destined to find its most notable expression thousands of years later in the noble cathedrals of Northern Europe. The problem presented by these Egyptian architects of the Theban supermacy was one of lighting the interior parts of the far extending temple halls. The difficulty was solved by lifting the central part of the hypostyle roof (a roof resting on columns) clear above the roof of the sides of the hall. The part of the hall which, higher than the parts adjoining, admits light through traceried openings is called a clere-story. A most important architectural result of this solution of the lighting problem was the development of a great central nave which for its proper construction necessitated details proportionate to its height and width. Larger shafts called for increased capitals. The bell-shaped or campaniform capital was used to meet the conditions of scale imposed by the new problem. The form was not a new one. It appears in the wall decorations of the earliest dynasties, and in the sanctuary area of the great Ammon Ra, Karnak, we find it cut in exquisitely

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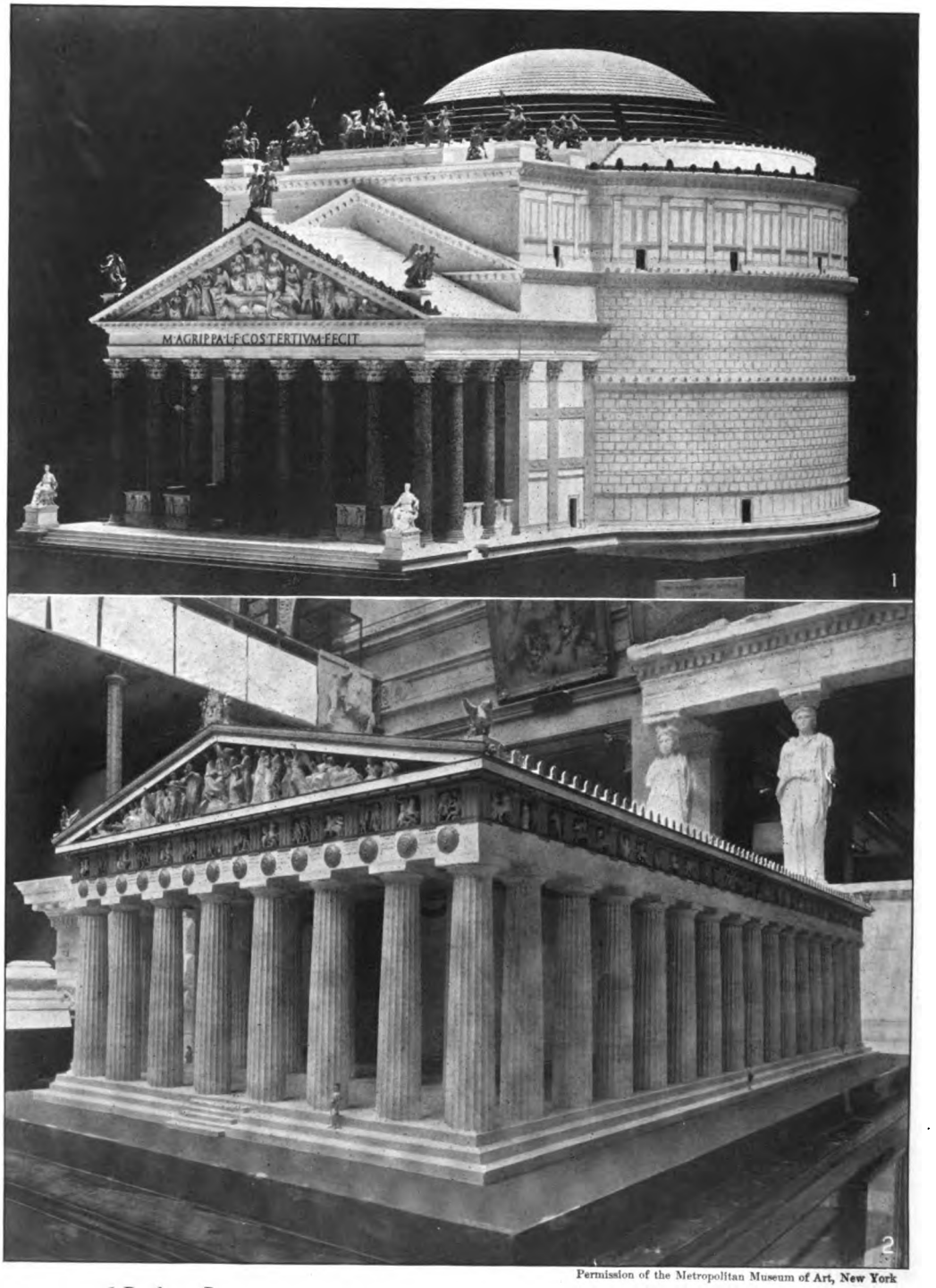
Hypostyle Hall, Karnak, Egypt



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1 Pantheon, Rome

2 Parthenon, Athens

executed relief upon a monolith that belonged to an older temple of the 12th dynasty. The bell shape accorded with the imagery of religious tradition, recalling either the papyrus or the lotus and it afforded profiles that solved effectively the problem of scale and surfaces, that, under the peculiar conditions of illumination would, to the best advantage, carry a curved and colored decoration. The artistic consistency of the Egyptian decorator is shown by the careful adjustment of his decorative lines to the profile of the embellished objects. The abacus block, borrowed originally from the proto-doric order, was retained as part of the calyx or bell capital. There being no connection between the vertical lines of this block and the flowering curves of the bell, an æsthetic discord resulted which the Egyptian artists were never able to obviate. The Greeks received this calyx order as an artistic heritage from the older civilization and developed a form, to-day called the Corinthian, which, in a mechanized Roman adaptation, appears frequently in modern architecture. The splendor of the Theban period was followed by a decadence that continued through the Saitic period (1000–324 B.C.) During the Revival (324 B.C.–330 A.D.) an epoch comprising Ptolemaic and Roman dominations foreign influence brought certain changes. While there was no attempt to create a new architecture, the eclecticism of the Greek and his love of light caused the innovation of a screen wall in place of the sombre pylons of the Pharonic temple. The simple decorated inverted bell capital of the former period was replaced by a variety of liberally carved modifications. The Greek influence is most typically expressed at Phylæ and Dendera, while the mechanization of Rome is shown at Koum Ombos and Edfu. The temple form in its general divisions underwent great change through all of the various eras of Egytian history. Its origins are lost in the mists of antiquity. Undoubtedly the early nature worshippers of Egypt did homage to a sacred stone or shaft. The holy object at first was unprotected, but in time an enclosing wall or wooden palisade more practically isolated it, creating a Temenos, or sacred enclosure. Early, too, a shelter was provided. Because the huts of the chiefs or leaders of the aborigines had been marked by wooden posts or stone shafts, this custom was employed to dignify the entrance to the simple shrine. In historic temples this procedure is reflected in the obelisks and great votive statues that were used to flank the entrances to the sacred edifice. As the temple, in the course of time, was looked upon not as a place of meeting for worshippers, but as a dwelling place for deity, whose presence was indicated by a consecrated effigy, provision had to be made for the people. To this end an antespace, an hypostyle hall was added to the shrine.

The progress of a race from a state of barbarism to one of enlightenment is always a slow and involved one, so that the simple temple, consisting of Temenos, hypostyle hall, and shrine must have been the result of a normal development extending over a period of thousands of years. With the increase of power and wealth on the part of the priests, and the development of a complex ritual, the shrine was divided into a number of chambers, the innermost of which, the *sekos*, enclosed the effigy or symbol of the god. The adjacent chambers were planned to contain the treasures of the sanctuary and in certain instances to be used in carrying out the intricate ceremonies of initiation into the secrets of the priesthood. The hypostyle hall was really a great ceremonial chamber. The title employed in the hieroglyphic inscription, the Hall of Appearance, clearly indicates its intention. Entrance to the *sekos* portion of the edifice was restricted to the superior priests and the king. At the celebration of religious rites the inferior priests would await the appearance of the emblem, a statue of the god, in the hall of the columns. In the earlier temples this feature was of modest size. In the southern temple of Karnak, but eight columns were required to support the hypostyle roof, but in the great temple of Ammon Ra, Karnak, 134 columns, arranged in 16 rows, were employed. Here the shafts supporting the clere-story ceiling were of colossal size—11 3/5 feet in diameter and 69 feet in height. The fact that it would require six men, with outstretched arms to span one of the huge columns will convey an idea of their bulk. This Hall of Assembly was separated from both the sanctuary and atrium or fore court by huge pylons. The ceremonial procession being marshalled, it advanced into the atrium, an hypæthral or open court, with colonnades upon two or three of its sides, seldom toward the entrance. As in the case of the Mohammedan mosques, the atrium served also as a place of instruction. Here, seated about their hieratic teachers, the Egyptian youth would pursue a curriculum that was unequalled in the ancient world. An enormous masonry screen, the pro-pylon, formed the façade of this court. This feature was generally composed of three parts, a central doorway and two flanking, truncated pyramidal towers. Its corners were decoratively strengthened with three-quarter round mouldings, and the summits of the three elements were crowned with the cavetto cornices. Recesses were built into the front to provide for masts, from which pennons were displayed. Provision was made in the interior for stairways and chambers, the purpose of which is unknown. The external and accessory parts of the temple scheme were the temenos, the sacred lake, and the Dromos. The elaborate ceremonies at the sacred lake made necessary an extensive fore-yard, an area hidden from the inquisitive eyes of the people. Before the mummy of the Egyptian, poor or rich, could be borne to its final resting place in the necropolis, it had to pass the ordeal, known as "the judgment of the dead." This trial was held upon the shore of the sacred lake, before a tribunal impersonating Osiris and his coadjutors. Proof of an evil life condemned the soul of the unworthy one to wander for 100 years in the world of the dead, and burial place for the mummy in the sacred precincts of the necropolis was refused.

Necessarily a large area was required for the enacting of this complex ritual, and the Temenos so used formed an important adjunct to the temple. It was enclosed with a wall 40 feet high and 33 feet thick, pierced by a monumental entrance. A paved causeway, the Dromos, formed the approach to this gateway.

It was decorated with sphinxes or kriosphinxes. The Dromos leading from Luxor to Karnak was 76 feet wide and was bordered with 500 kriosphinxes on each side of it.

As the hieratic imagery dictated in great measure the general plan of the Temple, so, too, the details were in many points subjectively treated. When the English architect, John Pennethorne, in 1833 made a tour of Egypt he discovered that in the atrium of the temple of Medinet Habou, erected by Rameses III, that the cornices were not constructed plumb and straight but were arranged horizontally as segments of circles. It is a notable fact that, whereas the Greek curves are traced in vertical planes, these Egyptian arcs are constructed in horizontal planes.

In 1890 Prof. W. H. Goodyear of the Brooklyn Institute found these curves to exist also in the Temple of Edfu, and the author in 1897 verified them by surveys at both Medinet Habou and Edfu. The reasons underlying the use of these curves are complex. It is evident that "all architectural lines that are curved in horizontal planes, convex to the position of the spectator, produce the effect of curves in elevation." Curves so formed exaggerate the effects of curvilinear perspective and the observer gets the effect of a building appreciably larger than the facts record. A mathematically straight line above the plane of the eye appears always as slightly concave, for the intersection of the plan of rays, that convey the line to the eye, with the hemispherical retina is a curve, and in all cases, not consciously corrected, is registered in the brain as a curve. If the reader will notice the way in which the cornice line of a block of houses gradually dips until in the distance it meets the plane of the street which in its turn has bent slightly upward, he will have an example of this phenomenon. In the case of the level street and the straight cornice we know that there is no actual curvature, but in the registration or perception of these distances the effect of a curve is produced. If, then, in experience, one finds that a long line above the eye is registered as a curve, how natural it would be if a shorter straight line above the eye were actually curved, to give to the shorter line thus curved the distance quality that would exist in a straight line that produced the illusion of an equal curve. The architects of Egypt had observed this curiosity of optics and with great care built the cornices of certain of their temples so that the cornices were actually curved as explained above. Then, too, under certain conditions a line, above the level of the eye, will appear concave, a result that is architecturally unpleasant. In order to overcome this disagreeable illusion, the ancient designers at times substituted a convex curve for a straight line. This last condition always results when the horizontal straight line is intersected by slanting lines. Thus the sloping planes of the pylons of the Egyptian temples being in the field of sight of a person observing the cornices of the forecourt, would tend to make the cornice lines of these courts appear concave unless these lines were really curved in the opposite or convex direction to overcome the illusion. As a matter of fact, to the modern traveler, the cornice lines of these temple courts appear straight and the courts in area seem to be greater than they actually are. In the wonders of Greek architecture these corrective methods were developed to a degree unthought of in Egypt. Many new conditions, material and subjective, were responsible for the system of Ictinus in the Parthenon at Athens. Another refinement in the Egyptian technique is found in the treatment of the four faces of the obelisks. These surfaces are curved outward both in the vertical and horizontal planes. This curvature was without doubt to correct the illusion of concavity resulting from the use of straight planes. Entasis, the slight bowing out of the shaft, was given to columns and pilasters for the same reason.

Chaldæan and Assyrian.— The civilization that was contemporary with Egypt was that of the Tigro-Euphrates Valley. Civilization of Chaldæa and Assyria alternately ruled in this valley until the conquest by the Persians. Its art and architecture was predominately royal. Extravagence and splendor marked the construction of palaces, especially those of Assyria, and the temples were comparatively moderate compared with the hieratic monuments of Egypt. Scarcity of timber and the difficulty of obtaining good stone for structural use forced the Mesopotamian monarchs to evolve a structural system adapted to the use of the available material. The solution of their structural problem developed the arch. To roof corridors or rooms, baked clay bricks were assembled on a curved form of wood. The bricks being inelastic material and in compression exerted lateral pressure or thrusts which were ultimately transmitted to walls or abutments. The thickness of the wall is proportionate to the amount of the arch thrust, and in the case of the Mesopotamian edifices, these superimposed weights were very great, hence the walls that held the load in check had to be enormously thick. The repetition of the arch, *i.e.* continuous arch formed a vault and the vault upon the circular base produced the dome. The column did not appear in Mesopotamian architecture as a constructive element. Palace architecture at Nineveh, Koyvndjic, Khorsabad and Nimroud exemplify the character of the Chaldæo-Assyrian palace. The religious architecture, exemplified by the ruins at Mugheir, Warka and Nippur, indicate terraced temples constructed with crude brick faced with burnt brick carefully set and often coated with enamel. Sculpture and relief, together with tile decoration, were used in the embellishment of the constructions of Chaldæa and Assyria. Winged bulls carved in high relief appear frequently as decorations of the jambs of arched gateways. Wall slabs of alabaster exquisitely carved in relief depicting subjects of war and hunting or of the king doing worship to his gods ornamentated the state apartments of the palaces. Individuality in design and ornamentation is lacking. The architecture throughout has the sombre stamp of officialdom. Expressing as it did the civilization with which Greece, Rome and Byzantium were in sympathy, Mesopotamian art became a fountain head of inspiration and influence for the arts of the Occident. That miracle of Justinian, the Church of Hagia Sophia in Constantinople had its origin in Mesopotamia.

Persia.— The mountain races of Persia,

previous to Cyrus, developed no architectural monuments. From the latter part of the 6th century, however, until the conquest of the Persian Empire by Alexander, 334 B.C., an architecture of terraced palaces and columned halls, laid out upon terraces and platforms, served to splendidly house the royal court and dependencies of the Persian monarchs, Cyrus the Great and his Achæmemidæ successors. At Pasargadae, Persepolis and Susa, are ruins scarcely yielding in point of decorative magnificence and impressive monumentality to the master works of Assyria and Chaldæa. The notable detail of Persian architecture is the capital and shaft, perhaps best expressed in the form employed in the palace at Persepolis. This capital was composed of the head and forelegs of recumbent bulls or lions between whose arched heads rested the beam that supported a timber roof. While it is a notable fact that the Persian bull kept his place unique in the history of architecture and is without derivatives, the supported entablature, developed after the wooden prototypes used by the ancestors of the Persians in constructing their huts, gave us the elements of the classic Ionic and Corinthian entablatures.

Hittites.— The source of many oft-repeated motifs in Egyptian, Mesopotamian and Minoan arts, certainly not originated by these civilizations, was the Hittites, from whose capitals at Kadesh and Carchemish, Western Asia and the Ægæan were controlled. The power of the race was overshadowed by the conquering arms of the Assyrians in the 8th century B. C. The architecture and art forms of this people are hardly known to us as yet. The curious pictorial records found in many places of Asia Minor are still the subject of much study by the Oriental philologist. It is certain, however, that many forms that appeared in the architecture of Mediæval and Renaissance times had their origins in the building activities of this race. At Senjirli extensive ruins of a fortified palace have been excavated. The gateway was planned as a portico. A guard room, the ceiling of which was supported by columns, intervened between the moat and the keep. The lower part of the walls of this room was decorated with reliefs of hunting scenes, and figures of gods, unmistakably Hittite. The columns were supported upon the backs of animal grotesques. In a relief at Boghaz-Keny the deities are represented as being supported by the symbols of temporal and mystic power. The lion, the king of beasts, represents in the most satisfactory way the idea of physical superiority. The double-headed eagle presents the idea of supernatural control. The two heads indicates the ability to gather all experience from the past and to forecast the future, in fine, a pictograph of omniscience. The persistency of artistic tradition is well illustrated in the way these Hittite forms have been transmitted from nation to nation, long ago having lost their significance in imagery, but ever striking in effect. The column carried upon the backs of animals was carved by the Assyrians in their decorative reliefs and the Etruscans carried the motif to Italy. The portal of the Romanesque cathedral at Verona exhibits its employment. In both the lower and upper colonnades of the entrance broadly treated grotesques support small Corinthianesque columns. All through northern and eastern Italy this imported Hittite motif was used. In designing ecclesiastical furniture this seemingly popular form was used continually. The Prior's Door of Ely cathedral, England, illustrates the introduction of the Hittite column form into English Norman work. In Italy, again, the pulpit that Nicolas Pisano carved for the Baptistry of Pisa, gave Renaissance expression to the ancient Hittite theme. So far researches among the scattered fragments in the rubbish heaps of Asia Minor oblige us to look upon the Hittites as the originators of an individual and vigorous art, the effect of which has been lasting and widespread. Art history, in part, must be rewritten and a place made for this virile nation. Important as their original contributions were, the greatest credit of the Hittites was in the fact that they were the principal mediating influence between Mesopotamia and Egypt in the East, and Greece, Etruria and Rome in the West.

Phœnicia and Cyprus.— Lesser intermediaries between Asiatic peoples, the Egyptians and the Greeks were the Cypriotes, Phœnicians and Lycians. It is possible that from Cyprus the Greeks borrowed the volute form in Ionic architecture, for it appears in the decorative patterns of pottery and Steles from Cyprus. The Phœnicians were purveyors of art. They developed that which was merchantable and produced quantities of objects, bronze, gold, terra cotta, glass and textiles. Little remains to-day of the military, civil or religious construction of this people. The military and civil constructions by which their cities were rendered almost impregnable seem to have been inspired by the Hittites, and the temple form, the general scheme of which constituted a cella divided into two parts and surrounded by a Temenos, was adapted from Egyptian sanctuaries, through the Hebrew mediation. The Hebrews did not originate a new style of architecture, and being prohibited by their religion from making graven images, "never developed a sculptural proficiency." They, nevertheless, occupy a most noteworthy place in the history of the world's art because the plans for their places of worship form the link between the temples of Egype and the shrines of Greece.

Lycia.— Lycia developed a serious art, in its earlier forms, constructed in wood; in its later phase these earlier types were translated into stone. Typical Lycian examples entirely of a mortuary character are to be found at Antiphellus, Myra and Telmissus in Asia Minor.

Phrygia.— The Phrygian Empire was at its height about 700 B.C. and occupied the plateau of Asia Minor. Many of the monuments that have been characterized as Phrygian are either original Hittite works or Phrygian constructions designed in the manner and style of the earlier art. Among the Phrygians, semi-barbaric wanderers and dwellers in tents, was the desire to fashion their tombs in the form of their earthly domiciles. This led to the representation of the patterned tent covering as a tomb façade decoration. The most interesting example of this design is known as the Tomb of Midas near Sivrihissar.

Lydia.— It is probable that the early Lydians were a division of the Phrygians. In Lydia as well as Caria the conical tumulus is

the characteristic form for monumental tombs. Developed in Asia Minor and transmitted through the medium of the Etruscans, Rome utilized the tumulus as the chief element for some of her most monumental efforts. The original inspiration for the Roman form which achieved its greatest expression in the noble Pantheon, the wonder of Roman construction, is to be found in the tumulus constructions erected by the early inhabitants of Thrace and Asia Minor.

Ægean.— While the early civilizations of the Egyptians and Hittites were developing, about the eastern Mediterranean there was formally established a great controlling empire which we have come to know as the Minoan. Recent explorations at Cnossus and Phæstus in Crete, and exploration of the Ionian Islands and the islands of the Ægean, various parts of the Peloponnesus and northern parts of Greece, have established the fact that Crete was the centre of the civilization whose wide ramifications extended from Egypt and Mesopotamia to the west shores of the Adriatic, Sardinia, Sicily and Spain. Ægean or Minoan art is divided into three periods, the first or early Minoan period comprised a semi-barbaric stone age civilization and a bronze age period. The close of the era is believed to have been about 2000 B.C. The middle Minoan period (2200–1400 B.C.) was the age of the early palace building. Wall painting was developed and the manufacture of fine faience was established. The first palaces at Cnossus and Phæstus were destroyed previous to 1850 B.C. The later palaces at these two sites were rebuilt and remodelled previous to 1400 B.C. There seems to have been no architectural group arrangement for the Minoan palace plan. Expediency and utility characterize the general arrangement. Numerous courts and confusedly arranged passages occur. In some portions one story was superimposed on another. A remarkable feature is the great staircase running through three stories. What appears to have been a theatral area, a paved court with banks of steps on two sides for the use of spectators, is a notable feature. The employment of a monumental stairway by the Minoans initiated a monumental structural feature that does not appear again until the Roman era. A knowledge of sanitary construction is evidenced by the exhumation of pottery drain tile. The appreciation of structural and sanitary systems, adapted to the needs of the Minoan civilization, established the existence of an architectural style which, for utility, was remarkable and in every way was superior to the clumsy experimentations of the dark ages which intervened between its use and the establishment of the classic periods of Greece and Rome. The late Minoan period reached its culmination about the time of the 18th dynasty of the new Egyptian Empire and is remarkable for a widespread building activity throughout the Ægean. The citadel palaces at Mycenæ and Tiryns belong to this period. The arch in its true form was not used by the Minoans but corbeled walls were used for the passages in the enclosing ramparts of the Tiryns citadel and the corbeled vault in circular form was employed in several tombs at Mycenæ and Orchomenos. At times the Minoan builders relieved stone lintels of superimposed weight by constructing above the lintel a false arch. The Gate of the Lions at Mycenæ is an instance of this construction.

Greece.— About 1100 B.C. the Ægean civilization succumbed to the age of iron, and on its ruins developed historic Greece. The experimental period closed with the victory over the Persians, 479 B.C., which established a consciousness of power that found its highest expression in the presentation of civic and religious ideals. This abstract conception was translated through the medium of the arts into terms intelligible to the mass of the people. The real secret of the perfection of Greek architecture is to be found in the fact that to the Greek mind religion and life were indissolubly interwoven. Their architecture was entirely a public architecture and the nucleus of this was the temple. Their early itinerary existence was filled with warlike struggle and religious worship. The shrine of beneficent deity served as the depository for their wealth and battle trophies. It was natural, therefore, in the development of the race, to base their subsequent public types upon those evolved in the perfection of the temple, a form that in each detail expressed the highest æsthetic and utilitarian value, effectually representing, in a concrete way, the Hellenic ideal of power. The earliest temples were mere rectangular enclosures devoid of ornament and without architectural pretense; selected because of the existence of some natural phenomenon, which appeared to indicate the presence of the gods or because the site had from primeval times been the place of worship of personifications of the forces of nature. In the archaic temple of Apollo, at Delos, there are two important parts, the cella and the space about the cella used for the performance of certain rites. These two elements that appear in this prehistoric example were retained by the builders of all Greek temples in more or less modified form. In no other place in Greece has an original primitive sanctuary been preserved. In the less sacred localities, the early cellas, we may suppose, were rudely constructed of timber. The first departure from the simple cella was the addition of an entrance porch. In front of and between the projecting side walls were placed piers or columns, similar to the scheme used at Beni Hassan in Egypt. This plan was the natural outcome of a more complex liturgy. There is every reason to believe that Doric architecture was the natural outcome of the problem of adapting the primitive wood superstructure, translated into stone, to the exigencies of a design in which columns were used for a porch in front of the temple. In course of time the idea of entirely surrounding the temple with columns suggested itself. The natural inference is that the peristyle entirely surrounding the edifice simply continued the tradition of the sacred area which originally surrounded the primitive temples. The great temples of Greece with few exceptions were designed in the Doric style, the elements of that order being best adapted to produce the effect of monumental equipoise and æsthetic concord. For the examples illustrating the experimental phases of the Doric style one must look to the archaic temples of Magna Græcia and Sicily, for the temples erected in Greece proper, during the 6th century B.C., have disappeared; in many cases, possibly along with

the Athena temple on the Acropolis, they were destroyed by the Persians; in the enthusiasm after Salamis the archaic edifices were felt to be unworthy of the gods who helped the Greeks to glorious victory, and they were replaced with more pretentious monuments. The northern temple of Selinus, 610–590 B.C., is heavy in detail and lacks the evident refinements of the works of later periods. The ideal of beauty was intimately associated with the religion of the Greeks and it was the constant effort of her artists to achieve a perfection of form and proportion. It follows that each shrine that was erected presented an opportunity to overcome any defects in composition that had become apparent in an earlier edifice. Thus each part of the architectural mass was carefully studied, the purpose being to produce an effect of absolute unity upon the observer. The transitional period (500–460 B.C.) exhibits in the temple of Zeus at Olympia and the Aphæa temple on the island of Ægina, a great advance in harmony of proportion and delicacy of detail. Sicilian temples of Segesta at Agrigentum and upon the acropolis and eastern plateau of Selinus, offer particularly striking contrasts to the archaic types. The final solution of the Peripteral temple arrangement was achieved during the Periclean era (460–400 B.C.) in the Parthenon (438 B.C.), the shrine of Athena Parthenos, the world's architectural masterpiece. In addition to the Parthenon the two great monuments of this age of Greek architecture were the Propylæa, the monumental gateway to the Acropolis of Athens, and the temple of Apollo Epicurius, at Phigalæa (Bassae); in the former many of the Parthenon refinements appear, but the latter, although attributed to Ictinius, the architect of the Parthenon, was wholly devoid of the wonderful subtleties of the Attic masterpiece. The Greek Ionic style, developed under the influence of Asiatic types, was not generally used in Greece until late in the 5th century when the Naval Confederacy brought Asia Minor and Continental Greece into relations. The style was universal in Ionic and Æolian territory, there being but a single Doric temple in Asia Minor. During the period of Pericles the Ionic order was used in the temple of Niké Apteros and the Erechtheion and the interior of the Propylæa on the Acropolis, Athens. The desire to simplify the execution of the various elements of the Doric style and reduce the time and cost of execution, led, during the Alexandrian (400–300 B.C.) and Decadent (300–100 B.C.) eras, to various debasements. Straight lines and geometric curves replaced the delicate refinements of the Periclean period. The capital from the portico of Philip 360 B.C., upon the Island of Delos, illustrates the dry and characterless appearance of the late Doric style. During the Periclean age a capital form of foreign origin made its appearance. On account of its florid gorgeousness of detail the innovation was called Corinthian. The type in a marked manner was an index to the national spirit of the period succeeding the Peloponnesian wars. The individual had asserted himself — no longer was the state and its glories uppermost in the minds of men. The pursuit of wealth, luxury and pleasure, caused the change in character and art and reflected the new conditions in the more sensuous styles of the Ionic and Corinthian. The Corinthian form never achieved the distinctiveness of an independent order in Greece. It was throughout a foreign element engrafted upon the Ionic style. It was only in Roman times that a Corinthian canon or rule was established. The Choragic monument of Lysicrates, at Athens, erected (325 B.C.) by Lysicrates, exhibits the possibilities of the Greek Corinthian style. While secular monuments propylæa, colonnades, stoæ, theatres, and odeons were constructed with architectural care and embellished with elaborate detail, little importance was given to domestic architecture and our knowledge of the Greek houses is principally derived from description. In general arrangement the domiciles must have resembled the houses of Pompeii.

Rome.— The situation at Rome was particularly advantageous for its work as an organizer. Her citizens had a special aptitude for government, but had neither the time nor inclination to evolve a new decorative style. Rome was adjoined by nations the value of whose art is still evidenced by remains of great monumental and engineering interest. The southern portion of Magna Græcia and Sicily was rich in examples of the Greek columnar styles erected by the Doric colonists who settled these districts during the 8th and 7th centuries B.C. To the north were the Etruscans, a people of Turanian origin, who migrated, according to conjecture, from Asia in the 13th century B.C. The Etruscans from the remotest antiquity possessed knowledge of the arch and simple vault construction. In their rectangular and circular temples we find the origins of the religious types of the Roman Empire. In the history of art, Roman architecture is of the greatest importance, because it is the fountain head out of which the styles of the Early Christian, Mediæval, Renaissance, and Modern eras were developed. It forms the connecting link between the practise of subsequent ages and the experimentations and perfections of the various peoples with whom the Romans came into contact. It must not be thought that Rome served as an artistic clearing house for the early arts and was wholly devoid of originality. As inventors they contributed to the resources of the designer the groined vault and dome, derivatives of the arch which revolutionized the science of planning, making possible the substitution of vast open interiors for the column encumbered halls of Egypt and the narrow structures of Greece, for in all of these earlier constructions the unobstructed areas were limited by the restriction of the lintel. The Etruscans employed the arch principle in the construction of barrelled vaults (a continuous arch roofing the space between parallel walls). The preservation of the Eternal City is due to a vaulted work of this kind. The Great Sewer, by which name the Cloaca Maxima is known, was built by the Etruscan tyrant, Tarquinius Superbus (500 B.C.). Symmetry was the dominant law of Roman composition, and in its employment the design was certain to achieve results that everyone could understand. Horizontal dual symmetry has an æsthetic value in that designs laid out in deference to its laws make an immediate appeal to all people. To the Roman, with his ideas of organization, simple symmetry was the best method of portraying his racial characteristic

Architecturally, the most important vaulted building was the Pantheon built by Hadrian between the years 117–138 A.D. The study of this monument inspired in the Florentine renaissance architect, Brunelleschi, the idea which he executed in the construction of the dome of Santa Maria del Fiore of Florence. With the Romans, the building of a great monument comprised two distinct operations, first, the fabrication of the ossature or core, and secondly, the envelope or decoration which was as independent of the construction as clothing is independent of the man. The necessity of rapid building and the availability of numerous unskilled laborers, drawn from the population of slaves and soldiers, rendered essential the development of a new constructive process. The solution of the problem was found in the use of concrete, not only for the walls, but also for the vaults and domes of their innumerable architectural undertakings. Great quantities of lime and cement rock are found in Italy, so that concrete of a fine grade was possible with a minimum of labor and cost. Skilled engineers would carefully plot out the lines of the foundations and walls and test the bearing power of the ground upon which the great vault supports were to stand. Hundreds of unskilled workmen excavated for the foundations and mixed the ingredients for the concrete. Chosen artisans laid up rough brick wall faces; the space between them was filled with concrete as fast as the faces were carried up. Then in a short time, the supporting walls would be raised to the height where the vaults were to commence. Temporary centres, or forms of wood, were then erected upon which the laborers moulded vaults. At times, in order to obviate the labor and expense of enormous timber centering, a light slat centre was used, upon which a vault of thin tiles set in hydraulic cement was laid. Upon this shell the concrete was heaped to the required thickness, rarely less than 6 feet over the thinest part. When the core of the monument was thus completed the task of decorating it was undertaken. Artists and precious materials were commandeered without regard to cost. The vaulted ceilings were embellished with moulded stock, lavishly painted and gilded, and the roof walls were covered with marble veneering, columns and entablatures. The decorative procedure of enveloping their arcuated masonry masses with columns and their accompanying accessories confronted the Roman architects with the problems of harmonizing in the same design the conflicting forms of the lintels and the arch. In the older arts, where the two constructive principles were used together, the arch had been placed above the lintel to relieve that weaker member from the weight of the superimposed mass (entrance to Pyramid of Cheops, Egypt). In the Imperial system the orders were introduced merely as ornamental features without constructive functions and the salient horizontal lines of the entablatures were designed to mark the division of the stories or the place of springing of great vaults. The columnar forms engaged to the masonry mass between the arches were introduced to give apparent support to the entablature. This arrangement inverted the position of the lintel and the arch as hitherto used, placing the weaker member above the stronger, and has been criticised as a reprehensible departure from structural propriety. The contention is not valid, however, for two obvious reasons; first, engaged columns necessitated an overhanging entablature whose projection beyond the face of the arch masonry indicated very clearly its introduction as an applied and not a structural feature, and secondly, through the contrast of the straight lines of the "Order" with the curves of the arches a pleasing variety was obtained, the popular value of which has been attested by the adoption and use of the Roman Arcade scheme in all subsequent styles even to our day. The columnar forms, as placed by the Romans, fulfilled, too, an æsthetic function in that they emphasized the constructional divisions and elements of the building and gave to the monuments a sparkle and play of light and shadow that added greatly to their appearance. The Romans being an essentially commercial people and their chief interests directed to the extension of their power, religious observations and its accompanying architecture were relegated to a subordinate place. Great halls for the transaction of business and the dispensing of justice assumed a far more important position. Luxury and the desire upon the part of the rulers to popularize their régimes necessitated the erection of fora, amphitheatres, baths, palaces, triumphal arches and a host of constructions such as aqueducts, roads, bridges, etc. The temples were of two types, rectangular and circular. The plans of both classes were of Etruscan origin. The rectangular shrine comprised of a deep porch led to the cella in which the statue of the deity was placed. Monumental stairways approached the porch. The circular temple plan achieved its most monumental results in Rome itself, although throughout the Latin world many minor monuments of this class were built. With the development of vaulting it was possible to greatly enlarge this type of structure until finally the imposing rotunda of the Pantheon was produced. The Roman basilica was a form adapted from the Greek royal house for the transaction of judicial and commercial business. Oblong in shape, it consisted of a broad and lofty central nave separated from double or single side aisles by colonnades. The roof of the nave was carried above the level of that of the side aisle forming a clere-story, which was pierced with windows. To the time of Constantine these structures were covered with wooden roofs, and it was that Emperor who completed the edifice commenced by Maxentius who first endowed the Basilica with a vaulted, fireproof covering. These basilicas are of especial importance because of the controlling influence that they exerted upon the later architectural styles of the Basilican, Byzantine, and Romanesque styles.

Early Christian or Romano-Christian.—The Emperor Constantine (328 A.D.) made christianity legal. Throughout the preceding four centuries Christian art had been slowly developing. Hidden and secret, its early forms were domestic or sepulchral. With the freedom of worship possible under the enlightened Constantine, the Christians appropriated for their religious edifices all that was adaptable in Roman architecture. The early Christians

translated in their liturgical forms the organization that they had become habituated to in the conduct of Roman affairs; thus the Basilica in which the business of the Empire had been transacted served as a basis for a proper housing for the performance of the public rites of Christians. The broad and lofty nave of the basilica with its single or double aisles, provided ample space for worshippers. Above the nave columns rose the lofty clere-story walls pierced with windows. Immense wooden trusses carried the roof of the nave. At the far end was the apse with seats for the clergy, and in front of the apse was the altar. Generally, a forecourt, surrounded by a covered arcade, preceded the basilica proper. This was connected with the church by a porch. One of the most impressive places of worship in the world to-day is the rebuilt basilica of Saint Paul without the walls at Rome, erected in 386 A.D. by Theodosius. In the general survey of architecture this edifice is of peculiar importance because the arches of the nave arcade are turned from column to column without the use of an intervening entablature between the capital of the column and the spring of the arch. The first known case of such use of columns as arch bearers was in the palace of Diocletian at Spalato. This nave arcade motif, modified by the structural changes of the Romanesque and Gothic periods finally flowered into the wonderful nave arcade conceptions of the ecclesiastical masterpieces of Amiens and Rheims.

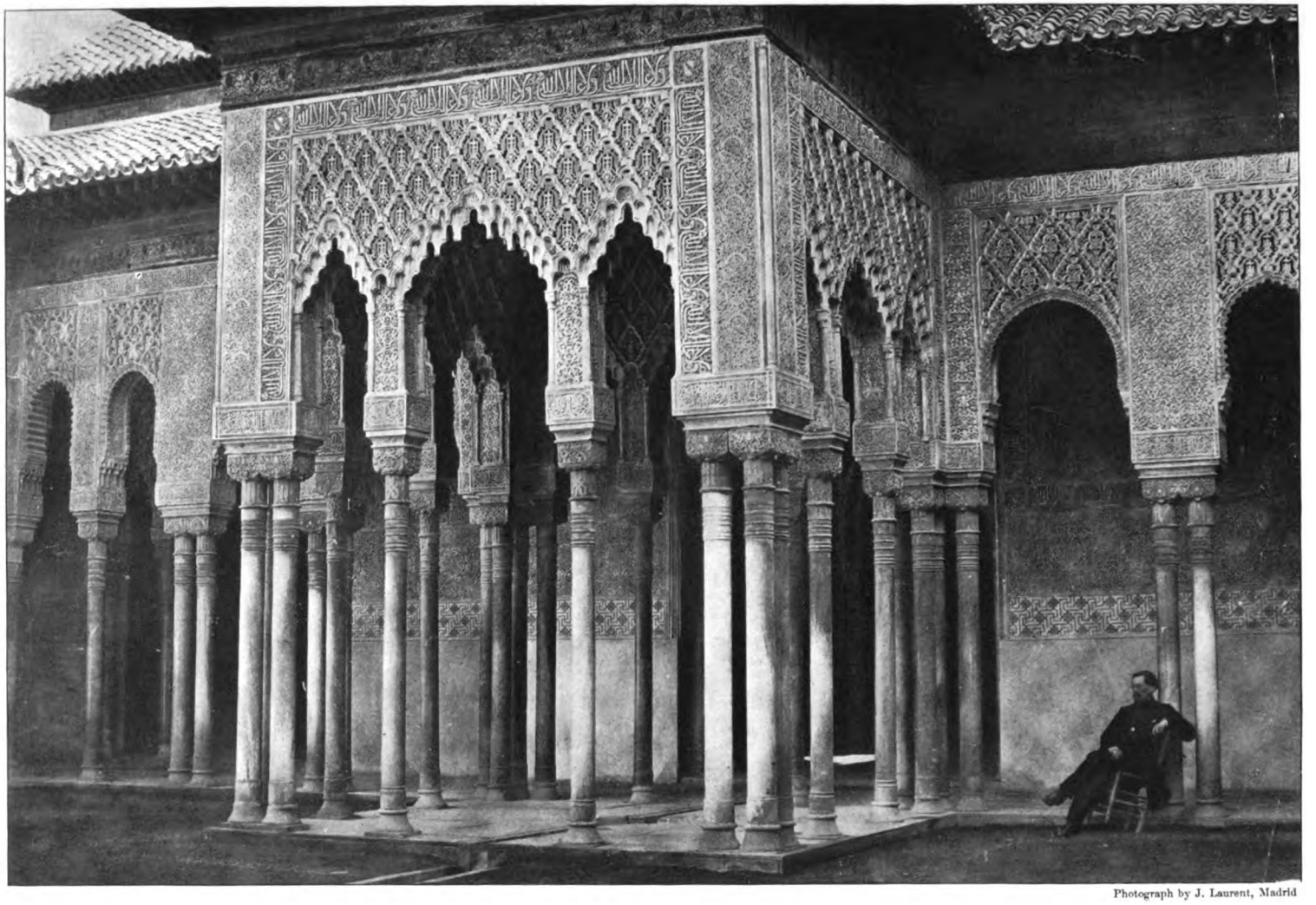
Byzantine.— Under Constantine, the Greek city Byzantium, renamed Constantinople, became the chief city of Christendom. Under Justinian, 527 to 565 A.D., the structural undertakings of the Eastern Empire developed an extraordinary activity especially in the building of churches. Syria, Dalmatia, Macedonia and Ravenna were scenes of architectural industry, for the most part under the direction of Asiatic Greeks. Engrafted upon the Latin type of church — the basilica with its three aisles and wooden roof — were certain traditional vaulting methods in brick and stone of Asiatic origin. The most notable characteristic of this structural method is the central dome on pendentives, a device by which a circular vault can be erected upon a series of isolated supports. By this scheme of dome construction polygonal chambers were built which could be monumentally roofed and would permit the floor plan to be extended indefinitely in any direction. The Byzantine plans are of great variety and enable the designer to achieve results which for propriety of scale and effectiveness of decoration have never been excelled. The great masterpiece of the style is Hagia Sophia, often called «Saint Sophia,» built under the orders of Justinian, 532–538 A.D., to replace an earlier Basilican building. This huge church, one of the greatest of the world's art masterpieces, marks the culmination of the style. It was followed by a long and gradual decline in artistic value. Some five centuries later a recrudescence of the style appears in the church of Saint Mark at Venice (1047–71), where a combination of Greek and Italian artists produced a masterpiece of great beauty which subsequently influenced the plan of the Romanesque church of Saint Front at Périgueux, France. The Romanesque cathedral of Cahors, France, was probably inspired by the Justinian church of the Holy Peace, Hagia Irené. All church building, even the latest and richest Gothic has the exterior for its chief splendor. The Byzantines apparently gave little thought to the embellishment of the exterior of their buildings, and lavished all of their decorative effort upon the interior. This style, invented in practically a single effort, a result not known to have been achieved anywhere else in the history of art, has prevailed ever since throughout the lands extending from the Red Sea northward through Russia.

Sasanian and Mohammedan.— Contemporaneous with the development of Roman and Byzantine rule under the Sasanian dynasties (227–641 A.D.) an art was developed in Western Asia based upon Hellenistic columnar precedent, combined with vaulted methods, the knowledge of which had its origin in the subterranean vaults and fragment domes of Mesopotamia. The royal palace at Ctesiphon, with its great eliptically arched hall, is a monumental example of the remarkable tenacity with which these Oriental peoples held fast to their own artistic traditions. The two Oriental lines of architectural influence lead, one toward the Far East, expressing itself in the types found in India and China; and the other in the Levant, embracing practically all of the countries which ultimately came under the faith of Islam. The architectural styles that followed in the wake of the Mohammedan conquests were marked by certain common characteristics which differentiate them from the contemporary Christian styles. The decorative consideration was ever controlling. Construction was relegated to a secondary place. Restricted by the Mohammedan canon there is an absence of illustrative decoration and sculpture throughout Arabic, Persian, Turkish and Indian buildings. The profuse conventional decoration that necessarily took the place of humanistic representation showed a great love for minute surface ornament. The mosque and tombs throughout the Arabic countries of the Mediterranean exhibit frequently a remarkable degree of decorative elegance. In northern Africa, the Arabs restricted construction and gave free play to decorative license. This particular phase of architectural expression is known as the Moresque style, horseshoe cusped arches were substituted for the simpler and structural architectural forms. Plaster relief entirely took the place of more endurable materials. Arabic architecture attained a remarkable splendor, curiously enough, not in Africa, but in Spain, the southern portion of which was overrun by the Moors, 710–713 A.D.; where petty kingdoms were developed most important of which were Granada, Seville and Toledo; until the capture of Granada in 1492 when the Moorish rule in Spain was ended, there was an extraordinary activity in building. Mosques, castles, acqueducts were reared and the climax of the style was reached in the construction of the great mosque at Cordova, the Giralda at Seville and the Alhambra at Granada, the latter universally considered to be the masterpicce of Hispano-Moresque art.

Persian architecture, after the Arab conquest was strongly influenced by the Sasanian

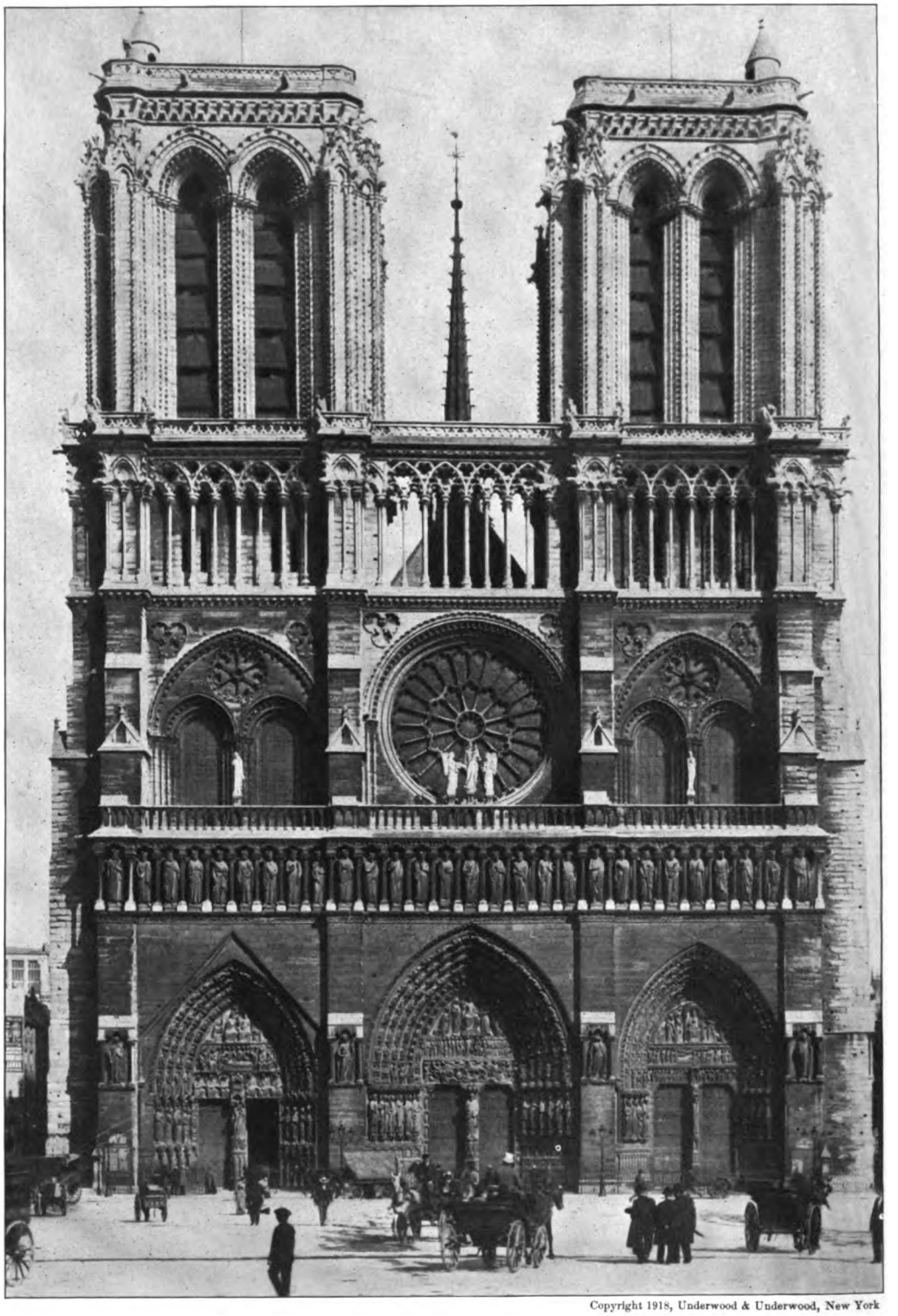
palaces. The dome and vault, the colossal portal-arches and the use of brick and tile evidence the Mesopotamian origin carried to Persia through the medium of Sasanian design. From Persia, the Mohammedan architecture of India received its inspiration and beginning in the 11th century there appears the growth of an Indo-Moslem architectural style characterized by a grandeur and amplitude of disposition and a symmetry and monumental dignity which, contrasted with the Moresque style of the Arabs, awards every advantage to Indian work. The dome on a square plan was almost universal. The Byzantine pendentive was not used, but in its place original combinations of vaulting surfaces of corbeling and ribs appear. Artistic settings for the monuments of this type are noted, and in the greatest of the Indian monuments, the Taj Mahal at Agra, the style possesses a production in which constructive science combined with noble proportions and exquisite beauty is unsurpassed by any of the greatest architectural triumphs of the world. After the conquest of Constantinople in 1453, the Christian church of Hagia Sophia was occupied as the chief mosque and served as an official type to control Turkish mosque design in plan and constructive principle. Thus, out of the Justinian edifice, was developed a style of architecture less decorative and voluptuous than the style of Persia, Africa, or India, but nevertheless of great dignity. The Turkish mosque, the Suleimaniyeh (1553), with its soaring minarets, serves as a Turkish type that governs to the present day.

Romanesque.—The Dark Ages that followed the fall of Rome (476 A.D.) constituted an experimental period during which the peoples of Europe were being Christianized and the influence of the Church was being established. Nations and individuals were groping for truth in government, religion and in life, and throughout Northern Italy, the Rhine Provinces, Ile de France, Southern France, Normandy, and Norman England, art in its various departments was called upon to express each stage of advance. Roman monuments existed in all parts of the Christianized regions, and these monuments of antiquity, serving as constructive models, inspired a new architecture, modified by the liturgical requirements of the early Christians. This architecture, primarily based upon the Roman, varying in each province according to the exigencies of climate, and the registration of racial characteristics in decorative form and structural inventiveness, is known under the generic title of the Romanesque Style. In Tuscany, the churches were Basilican in plan with timbered ceilings and high clerestory. In Lombardy, in the 11th and 12th centuries the Basilican plans of classic Italy were translated into stone. Variations in plan resulted from the necessities of the lithic problems. The naves were narrowed and instead of rows of columns carrying a high clere-story wall, as used in the Tuscan Romanesque churches, heavy piers connected by wide-spreading nave arches supported the heavy ribs of the roof vaulting as in S. Ambrogio, Milan. During the 11th and 12th centuries in Northern and Western Europe, the church builders labored to adapt, like the Lombards in Italy, the Basilican plan to the requirements of vaulted construction. Throughout France, Western Germany, England and Belgium, the designers were constantly in trouble, caused by the difficulty of building the round arched vault over the several portions of the churches. The thrusts of the clumsy vaults used to roof the nave were inadequately resisted by half barreled vaults over the side aisles, through the medium of which the strains of the great central vaults were transmitted to enormously heavy side walls. In these cases the clere-story necessarily disappeared and the lighting problem, which did not amount to much in the southern provinces, became a serious consideration in the cloudy regions of the north. There it was necessary to raise the nave vault higher in order to introduce clere-story windows. To accomplish the introduction of the clere-story windows groined vaults replaced the barreled vault. The introduction of the groined vault made possible the concentration of the roof thrusts upon a series of isolated supports or clustered piers. The groined vaults were of two forms, four-part and six-part. The *four-part vault* is perhaps best typified in the church at Vézelay, France. The *six-part vault* was used in Normandy in the Abbaye aux Hommes and the Abbaye aux Dames built in the time of William the Conqueror. The use of the six-part vault in these churches, while making possible a higher clere-story, was an awkward expedient, for the division of the square vaulting bay into six parts by the diagonal groinings and a middle transverse rib, necessitated two narrow skew vaults meeting at the centre of the vaulting bay. Although an unsatisfactory device, this vaulting scheme was retained for a hundred years or more, and even after the adoption of the pointed arch form, it was common in the 12th century churches, both in France and in England. In constructing these vaults, the various ribs were erected independently of the vaulting surfaces, a principle of construction which the Romans had used in their concrete vaults. The buttressing necessary to support the various vaulted roofs was mainly internal and unsatisfactory. Subsequent to the Norman conquest, 1066, church and abbey building was greatly stimulated. Typical of the period in England and expressing the two various phases of the Norman style in England, are the cathedrals of Durham (1096) and Ely (1107). The original vaulting scheme of Durham was borrowed from the six-part vault method employed in Normandy. The instability of the six-part Norman construction is evidenced by the fact that the early vaults at Durham were replaced by four-part Romanesque construction. The English churches differ from the Continental edifices in two particulars. First, a huge tower was usually erected over the crossing of the nave and the transept, and secondly, the western portals were not emphasized. At Ely there appears a notable variant from the Durham Norman style, due conjecturally, to the influence of the Tuscan Romanesque. At Ely a bascilican church was designed in which the graceful and elegant details of the Italian Pisan churches was replaced by the heavy forms of the Norman art used not in a structure but, a wholly decorative manner. A timber ceiling was used instead of stone vaults. This



Photograph by J. Laurent, Madrid

Western pavilion of the Court of Lions, Alhambra, Spain



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Cathedral of Notre Dame, Paris

phase of the English Norman is practically nothing more than the Italian Basilica with a Norman envelope. In Germany a few churches dating back to the 9th century, in great part rebuilt, express the character of this period in that region. The church at Aix-la-Chapelle in Prussia has been greatly altered, but it was without a doubt inspired by that of San Vitale at Ravenna. The Byzantine type here shown was repeated in a number of later churches. The conventual church at Hechingen, near Stuttgart, and at Quedlinburg, Saxony, exhibited quasi-classical sculpture with scroll work and elaborate mouldings. Groined vaults, low and narrow, are used. The same timidity and lack of stability in vault construction is apparent here as in other parts of Europe. The great cathedral of Speyer, Bavaria, and the church at Gernrode belong to the 12th century, as do the church of Saint Michael at Hildesheim, the cathedral of Mayence, and the cathedral at Worms. These churches have been practically unchanged since the time of their building, and exhibit perhaps the most efficient examples of the Romanesque style. The Romanesque influence expresses itself in the far north in the cathedral of Lund in Sweden with the characteristics of the architecture of the period. The Scandinavian Peninsula depended for the most part upon timber for its construction and upon elaborate carving for its decoration. In Spain the Moors dominated the larger part of that country during the Romanesque era, but after the capture of Toledo (1062) by the Christians, there was a recession of Moorish influence, and in the northern provinces of Spain a number of important churches were erected which reflected the influence of French Romanesque models. The Church of Saint Iago at Compostella is typical of these Spanish Romanesque edifices. Barrel vaults over the nave, groin vaulting over the side aisles, follow the precedents of France. In the employment of a dome or cupola, as in the old cathedral at Salamanca, over the crossing of the nave and transepts is exhibited a characteristic departure from the French types.

Gothic.— The practical difficulties encountered by the Romanesque builders found a structural solution during the 12th century, when, under the influences of a firmly established state and a supremacy of episcopacy over monastic provincialism, ecclesiastical architecture assumed a foremost place in the social organization of the time. The basic principles of the Gothic styles were, first, *the concentration of thrusts upon isolated points of support*, a method adopted by the late Romanesque designers in their substitution of groined for barrel vaults, and, second, *balanced thrusts*, by which the strain weights exerted by the stone vaults were opposed by counter-thrusts, until these various thrusts were concentrated into a final resultant pressure which was transmitted by flying half-arches to external buttresses. The natural corollaries, whose development was forced through the application of those two principles, were *ribbed vaulting* and the *pointed arch*. This latter feature had been used in the Romanesque period, but it remained for the Gothic creators to appreciate its full structural possibilities. They built their groin ribs of semi-circular or pointed form, but the wall ribs were, without exception, pointed arches of such curvature as would bring the apex of each nearly to the level of the groin intersection. The pointed arch, thus introduced as a structural device for the vaulting ribs, necessarily determined the profiles of the windows and nave arches. The advance in constructive science made possible the enlargement of the windows and the suppression of enclosing walls, conditions which promoted the use of stained glass and the necessary tracery for the support of the glass. The constructive supports were carefully moulded and buttresses were terminated with pinnacles — structural propriety was emphasized by decorative embellishment until there was produced a complex of constructive beauty which in its mystery and vivacity harmoniously presented the great ethical ideal of deity. The various styles of Gothic are universally differentiated by the character of the window tracery. The *formative era* is known as the *Early Pointed Period* (1160–1275). The simplicity and conventional treatment of structure and detail of this period gradually underwent change. In the *Middle Pointed Period* (1275–1375), knowledge of construction brought perfection in vaulting, and skill, resulting from training, developed a school of sculptors who delighted in the expression of naturalistic forms of mature foliage. The tracery, with its slender moulded bars and geometric combinations reflected the varieties of the achieved structural science. Skill and fancy finally suppressed the decorous art of the Middle Pointed Period, and *flowing* or *flamboyant* tracery in France and *perpendicular* bars and four centred arches in England and "*branch-tracery*" in Germany characterized the final or *Floric Gothic* (1375–1525).

The masterpieces of cathedral design are Notre Dame, Paris, Amiens, Rheims, in France; Canterbury, Lincoln and Salisbury in England; Strassburg and Cologne in Germany; the Cathedral of Antwerp in Belgium and the noble structures at Toledo and Burgos in Spain. In Italy civic pride expressed itself typically in the imposing edifice at Milan and Santa Maria del Fiore at Florence.

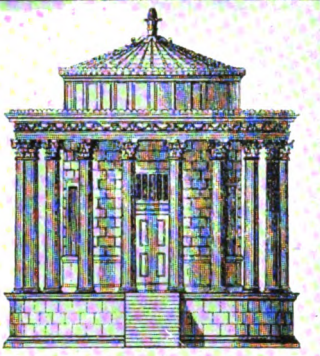
Renaissance.— During the Mediæval period arbitrary authority and ecclesiastical organization had inhibited the individual expression of human intellect and will. During the 12th and 13th centuries in Italy, the restrictions of dogmatism and centralized arbitrary authority and artificial union gradually gave way before the tide of Humanism, a movement that was related to every phase of life and expressed itself sympathetically in a reapplication of classic methods and an adaptation of antique art to the requirements of the period of the Rebirth, or Renaissance. Back, almost in the Dark Ages, may be found the beginnings of this movement. Classicism had never lost its influence among the scholars of the East and in mediæval times the intellectual centres of Italy were continually influenced by the teachings of visiting Greeks from Constantinople. The living examples of Roman and Greek art that showed their types of studied beauty continually before their eyes could not fail to affect the literature and art of Italy. A group of men who laid the foundation for the registering of the exultant awakening of modern thought and life, were Petrarch; Giotto (the architect-sculptor); the Pizani; Brunelleschi (architect and structural inventor); Donatello (sculptor), and Masaccio (the

apostle of individualism). The entire gamut of nature forms and the whole fundament of Roman structural possibilities and decorative individualism was made plain to the world in the teachings of the masterpieces produced by them. As the result of foreign invasion and commercial intercourse, the Humanistic styles of Italy came early in contact with France, the Netherlands, Germany, England and Spain. In Italy, "although the new architecture began with the colossal dome of the Cathedral of Florence and culminated with the stupendous church of Saint Peter, at Rome, it was predominantly an architecture of palaces and villas, of façades and decorative display. Constructive difficulties were reduced to their lowest terms and the constructive framework was concealed, not emphasized by the decorative apparel of the design." Among the masterpieces of the Renaissance are many buildings of small dimensions, such as gates, chapels, tombs and fountains. In these, the individual fancy had full sway and produced surprising results by the beauty of carved detail. While the general styles of the Renaissance in all countries may be divided into the *formative period,* the *classic period,* the *decline* and the *rococo* period, nevertheless on account of the personal expression of the styles, the real name that should be assigned to a given period should be the name of the great master of an era. The architectural *motifs* instituted by Brunelleschi in the construction of the dome of Santa Maria del Fiore in Florence (1420), and the Pazzi Chapel (1429); the Church of Santa Maria Novella (1456) and the Strozzi (1490) and Rucellai (1460), Palaces, Florence by Alberti; the Cancelleria (1500), the "Tempietto" (1500), at San Pietro in Montorio by Bramante in Rome; the Farnese palace (1520), by San Gallo; the Massimi palace (1531), Rome, by Peruzzi, the dome of Saint Peter's (1564), at Rome by Michelangelo; the Palace Pompeii (1530), Verona, by Sanmicheli; the Basilica, Vicenza (1560), by Palladio; the Palace Caprarola (1530), by Vignola; the Palace Grimani (1535), Venice, by Sanmicheli; the Library of Saint Mark (1536), by Sansovino, Venice, and Santa Maria della Salute (1631), by Longhena, Venice, are types establishing styles of architectural composition and decoration that continued strong in their influence from the time of their creation to the present day. These edifices are true indices characteristic of the Humanesque civilization in Italy. They are essentially products of adaptation, and, involving no new principles of construction, did not have inherent in their styles the germ of a new architecture. The Italian campaigns of Charles VIII (1489), Louis XII (1499), and Francis I (1515), resulted in the introduction of Italian culture into France. The personal contact made possible by these military activities emphasized a developing love for the luxurious facilities for living and the new mental bearing toward life resulting from an understanding of the æsthetic classic attitude. The structural character of the early French Renaissance was feudal. In the Royal Chateaux the military structural character compromised with Italian decorative styles and evolved a *formative Renaissance art* distinguished for its picturesqueness and the free and exuberant use of classic detail. This *blending period* occupied practically the entire era of the Valois rule and covers the styles of the transition (1483 to 1515), the style of Francis I (1520–47), and the style of the advanced Renaissance (1547–89), by which time the classic methods of design had replaced the delicacy, richness and picturesqueness of the Formative period. *The Classic era,* with the fulsome, florid styles of Henry IV, Louis XIV followed, succeeded in 1715 by the extravagances and capriciousness of the *Rococo period.* Several edifices reflect in the broadest artistic sense the stylistic peculiarities of these three eras of the French Renaissance. The Chateaux at Blois, begun by Louis XII depicts all of the variations of the Blending or Formative period. The increasing use of the orders of architecture and the restrictive following of antique precedents exhibited in the Luxembourg Palace, the monumental colonnade of the Louvre, the Hotel des Invalides, and the Place Vendôme exhibit the stage of development under the Bourbons. License overcame, under Louis XV, the monumental observations of formal principles of classic design. The notable exceptions to this general trend of capriciousness is found in the works of the Ecole Militaire, originally terminating the Champ de Mars, and the two imposing edifices, adorned with monumental colonnades, of the Place de la Concorde, Paris, planned by the gifted Gabriel, which are the great architectural achievements of the period of the Decline, and, while the style of Louis XV itself was a style that characteristically avoided the formality that distinguishes classic design, these particular works have served as inspiring examples for all subsequent architects. The style of the Decline was halted by the revival of interest in things of classic origin during the period of reaction under Louis XV and the Empire, when in the Panthéon and the Madeleine and the Arc de l'Etoile there was a registration of the conviction that the translation of grandeur was possible only through the expression in architectural forms of classic Roman canon. The artistic history of the Louvre is an epitome of the entire history of French architectural development. Commenced under Francis I (1546), the beginning exhibits an Italian character. The work associated with the reigns of Henry II, Charles IX and Henry III (1547 to 1589), characterize the developing Renaissance. The additions made during the reigns of Henry IV, Louis XIII and Louis XIV exhibit the development of the orders and matured Renaissance method, while the colonnade under Louis XIV types the high water mark of Classicism. Napoleon I added his quota, and under Napoleon III, the Empire found its expression in what is now known as the New Louvre, two wings projecting from the old palace.

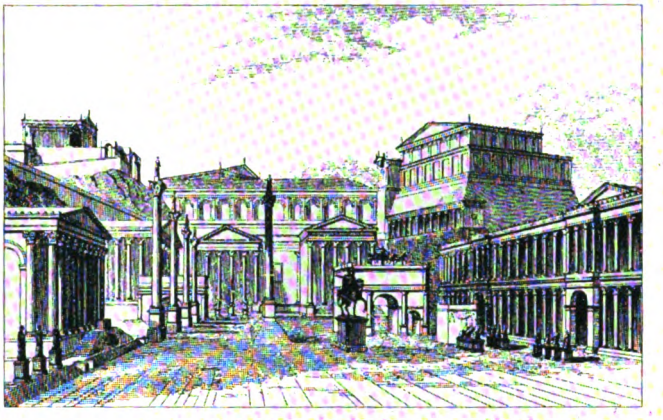
In England, The Netherlands and Germany, during the time contemporaneous with the Valois era in France, the great country mansions, manor houses and palaces were the first to receive and show Italian influence. The Renaissance in England makes its first feeble appearance in a decorative way during the Tudor period, a debased Gothic style. There followed during the Elizabethan period (1566–1603), by Dutch and Italian artists, a curious mixture of Gothic and Italian forms, which is

ARCH OF TITUS, ROME.

MONUMENT OF LYSICRATES.

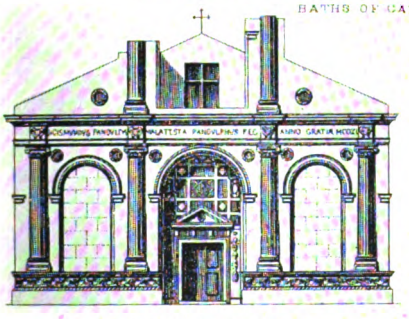


TEMPLE OF VESTA, TIVOLI.

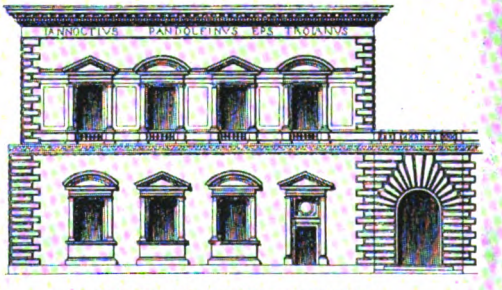


RESTORATION OF THE FORUM, ROME.

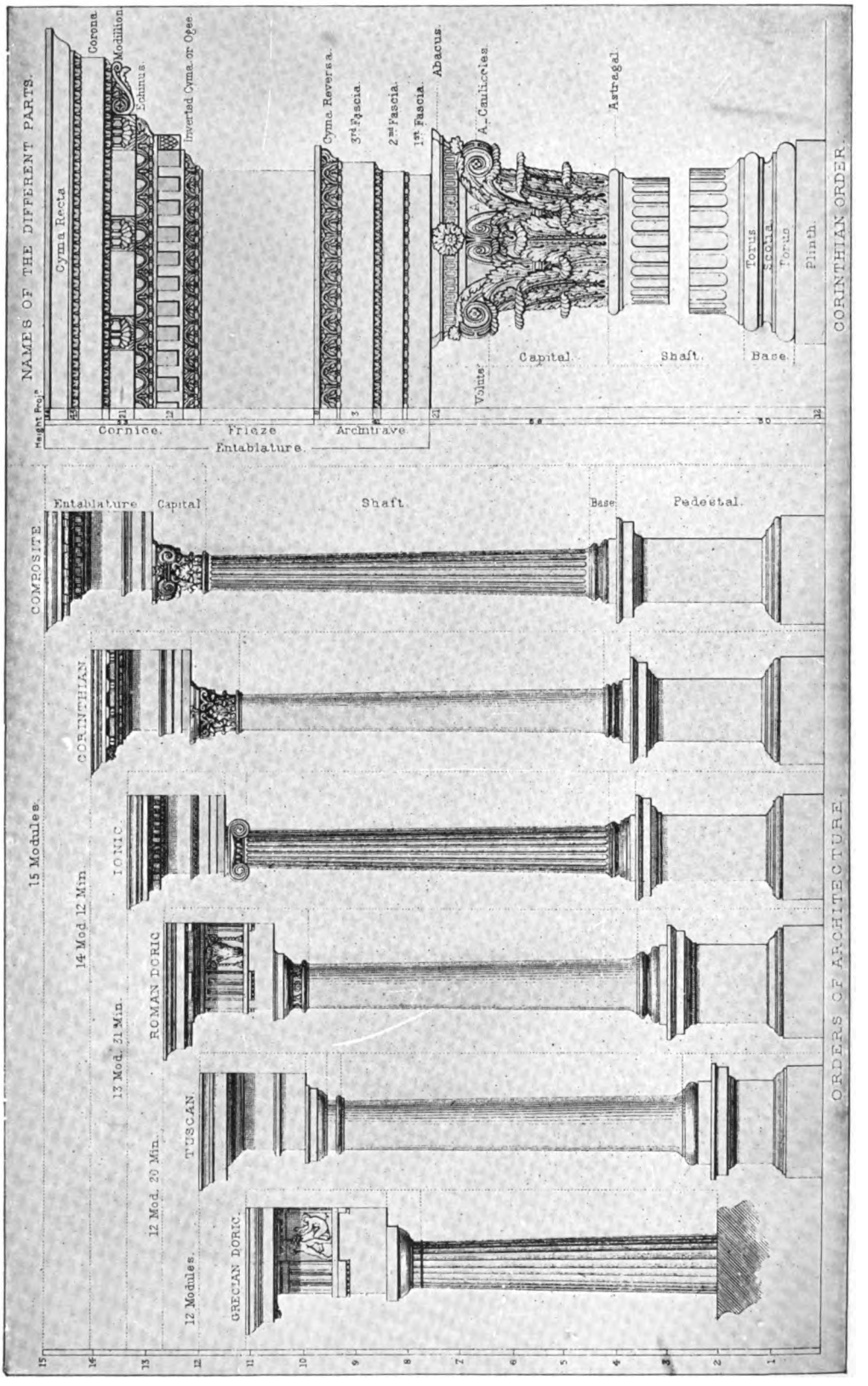
BATHS OF CARACALLA, ROME. (Restored)



CHURCH AT RIMINI.



PALAZZO PANDOLFINI, FLORENCE.


NAMES OF THE DIFFERENT PARTS.
Cyma Recta.
Corona.
Modillion.
Echinus.
Inverted Cyma or Ogee.
Cyma Reversa.
3rd Fascia.
2nd Fascia.
1st Fascia.
Abacus.
A. Cauliculus.
Astragal.
Volute.
Capital.
Shaft.
Base.
Torus.
Scotia.
Torus.
Plinth.
Cornice.
Frieze
Architrave.
Entablature.
CORINTHIAN ORDER.
ORDERS OF ARCHITECTURE.
15 Modules.
COMPOSITE.
Entablature.
Capital.
Shaft.
Base.
Pedestal.
14 Mod. 12 Min.
CORINTHIAN.
13 Mod. 21 Min.
IONIC.
12 Mod. 20 Min.
ROMAN DORIC.
12 Modules.
TUSCAN.
GRECIAN DORIC.

well exemplified in the Burghley House. Details of freely treated classic forms, which came into use during the reign of James I (1603–25), illustrate the Jacobean style. This style in reality was the introduction to the Classic period in which, under Inigo Jones (1572–1652) and Sir Christopher Wren, (1632–1723), correctly proportioned and monumentally conceived public works were erected. The palace at Whitehall (Jones) and Saint Paul's Cathedral (Wren) summarize the achievements of this period. Under the Georges a revival of Roman precedents, due to the genius of Robert Adam (1728–92), took place. With the idea that the architect should control all phases of his design, including even interior decorations and furniture, the name of Adam became synonymous with an English decorative school that produced results showing a rare taste in combining classic motifs with fertile fancy. The abandonment during the late Georgian period of the stiffness of the earlier era marks the characteristic of the style that served as the fountain head from which the American colonies borrowed models of their earliest architecture. The American churches were adapted from the Wren-Gibbs precedents (Saint Paul's, New York 1766). The drawings of Adam and his associates affected all phases of the domestic design. The translations into wood and brick of the Georgian stone *motifs* distinguished the early American style to which the name Colonial has been applied. (Mt. Vernon, the Home of General Washington).

The same general progression that marked the development of the Renaissance styles in France occurred in Germany, although the periods are not as definitely established. Beginning late (1555) the change from Gothic to Classic was rapid. Unlike France, the chief examples of the various periods are for the most part confined to secular architecture. In castles, town halls and corporation houses, irregularity of plan and a tendency to distribute ornament freely over façades, feature the German Renaissance. The orderly character of the French and Italian designer is replaced by the personal preferences of the German carver. The highest achievement of the era is the Castle of Heidelberg (1601) and its climax is reached in the degraded use of Rococo ornament in the Zwinger Palace, Dresden.

In Spain skill in metal work and delicate carving characterize a free and joyous application of Italian Renaissance forms to constructions of the early 16th century. This style, known as the *Plateresque* (1556), was widespread throughout Spain. The portal of the University at Salamanca and the Church of San Domingo at Salamanca are excellent examples of the style. The artistic barrenness of the reign of Philip II was followed by a cold classic era — Griego-Romano — whose masterpiece was the Escurial, completed by the great Herrera. The palace of Charles V, adjoining the Alhambra, Granada, by Beruguete exhibits the Spanish adaptation of the Italian-Paladian style. Toward the end of the 17th century a period of decadence set in during which debased taste and the throwing aside of all architectural restraint gave rise to the style *Churrigueresque*.

The Netherlands were late in re-acting to the influence of Humanism and, in general, tended toward florid and unrestricted combinations of Italian, Spanish and French precedents.

Modern.— During the latter half of the 18th century a great activity in archæological research took place. Scientific examination of classic and pre-classic monuments and sites was undertaken, which procedure, with increasing enthusiasm, has continued to the present day. Academic theory and fanciful classic idealism gave way to definite and rational understanding of Roman and Greek methods of construction. The first effect of the publication of archæological research inspired the ambition upon the part of designers in various countries to design and construct after the form of the classic prototypes. This structural interest gave rise during the first half of the 19th century to the Greek and Roman classic revivals. The works of Piranesi, Lord Burlington, the illustrated description of the excavations at Pompeii, Herculanæum, Palmyra and Baalbek and Spalato, stimulated a Roman revival which in France expressed itself structurally in the Panthéon (1759–90) in which the dome and the porch of the Pantheon in Rome was the prototype. Napoleon commissioned Vignon (1807) to erect the Church of the Madeleine, a design whose interior is based upon the Roman Thermæ and its exterior a monumental peristyle of Roman Corinthian columns. The column of Trajan in Rome inspired the Napoleonic column of the Place Vendôme, and the various monumental arches of triumph re-echo the Roman triumph forms.

The publications of Greek archæological research, the antiquities of Athens by Stuart and Revett, Paestum by Major, the practical interest of Lord Elgin, and particularly the history of art by Winckelman, issued synchronously with the works of Stuart and Revett, in which the enunciation of the principle that a canonical relation between a whole and the various parts of a structure was necessary to produce an harmonious and balanced result forced the acceptance by many of the belief that the prototypes of a perfect architecture were to be found not in Roman examples but in Hellenic. Many buildings were therefore erected in England, Germany, France and America in the style of the Greek revival, in which Greek Ionic and Doric columns and details were used in profusion. While monumentality and dignity were obtained, the failure to appreciate the interdependence of the functions of Greek sculpture and Greek architecture with its then unknown refinements, resulted for the most part in an architectural style that was lacking in animation and national character. In Germany, the Greek revival was frequently modified to meet the needs of modern conditions, and while archæological correctness was to a degree subordinate, the more rational use of the Greek forms achieved a better style than in England. The style in England is exemplified by the Bank of England (1788), the British Museum (1823), Saint George's Hall, Liverpool (1815), and in Germany by the Brandenburg Gate, Berlin (1784), the Old Museum, Berlin, and the Propylæa, Munich, and in America is best expressed in the

Treasury, Washington, the old Custom House, New York, Girard College, Philadelphia, and the State House, Albany.

The results shown in the architectural monuments of the period in Germany, England and America were disappointing, for architecture to be completely successful must reflect the conditions of the civilization whose activities it is planned to house. The impossibility of instilling into modern life the conditioning causes of a dead civilization, made it impossible for the structural forms that were employed to reflect the functioning of the civilization of today.

In France the enthusiasm that resulted from the Greek revival stimulated an ambition for added refinement and purity. The delicacy of detail and the spirit of spontaneity that marks the Library of the École des Beaux-Arts and the Library of Ste. Genevieve exhibit well the possibilities of the æsthetic influence of Greek types.

Contemporaneous with the Roman and Greek revivals due to the influence of scholars and artists who travelled in the Far East, a pseudo-Chinese design became the vogue for many porticoes, pavilions and landscape accessories throughout France and England. The novelty and decorative possibilities of this Oriental influence, although for years imperfectly understood, have markedly influenced sportive and landscape design to the present day.

In Great Britain, about the middle of the 19th century, there appeared a revival founded upon the national Gothic architecture. The movement known as *Victorian Gothic* had its beginning in an archæological enthusiasm in which the decorative possibilities of English Gothic caused many misapplications of the Insular Gothic forms. Subsequent to 1850, archæological method gave way to an intelligent effort to adapt the Gothic principles to modern requirements, as the result of which activity there arose a number of monuments imposing in mass and refined in detail, the most successful of which is the building that houses Parliament at Westminster, London. The influence of this style extended to America during the last 40 years, but having no deep foundation in national requirements it has fallen into disuse and, like the Greek and Roman styles, has been replaced by designs founded upon Renaissance principles. In France, the 19th century Gothic revival very slightly affected the development of the modern Renaissance. The few buildings that were erected are generally superior to the English examples resulting from the same influence, in that the structural side of the problem has been scientifically dealt with; for the English and American interiors of the pseudo-Gothic style, for the most part completed with plasterwork, compared unfavorably with the French constructions in that, in France, the vaultings and dependent details are executed in masonry. Among the various nations in Europe, *eclecticism* made itself apparent during the last quarter of the 19th century. In modern times, the desire for truth and logic through structural form has appeared in a number of successful buildings in France, Germany and England. Perhaps the most remarkable example of eclecticism is the Trocadéro, Paris. It is impossible to classify this edifice according to architectural styles, but fulfilling its functions as a great Expositional Building, it is typical of the possibilities of a structurally trained architectural mind, in which license and extravagance are restrained by a knowledge of stylistic precedents.

The United States.— It has been the experience of all civilizations that a national art is not attained until there has been developed a suitable centralized authority, possible only with the establishment of a political and commercial independence. A nation achieves such a position after a long struggle, and, from the time of primitive conditions each step in the formation of an effective national life is marked by architectural and constructive methods which punctuate the epochs of the country's advance. Commercial conditions, utilitarian requirements and scientific discovery necessitate modifications in structural procedure and types of plan and mass composition adapted to new and local requirements. Dependence upon historic antecedents is continually evident. The historic development of the architecture of the United States aptly illustrates the conditions that must surround and control the evolution of architecture and its dependent arts in a growing and virile nation. From the time of the colonization of America, until the first half of the 18th century, building was confined almost entirely to sheltering and utility structures. During the period from 1725 to 1776, increase in wealth and population brought about a style based upon that in vogue in England at the time. Trained architects were not to be had in the colonies and the models which set the colonial fashion, due to lack of training of America's builders in classic traditions and the necessity of alterations caused by the use of brick and wood instead of stone, produced an architecture, which, while interesting, had no truly monumental character. In churches in New England and the Middle States, the English designs by Wren and Gibbs obviously served as prototypes and the influence of Adam and Sheraton is patent. Craigie House, Cambridge; Independence Hall at Philadelphia and the Old State House at Boston, while refined in mass and detail are not monumentally striking. In the West, influenced by Spanish types, were built picturesque mission buildings, and a few churches and secular buildings which exhibited a translated phase of the Spanish Churrigueresque. The era between 1776 to 1812 following the growth of the national government and the development of Federal strength, a characteristic monumentality became evident as is well exemplified in the central portion of the present Capitol at Washington, the City Hall, New York, and the State House at Boston. The enthusiasm which resulted from the archæological discoveries in classic lands spread to the United States, and previous to 1850 resulted in an architectural classic revival. The chaotic conditions surrounding the Civil War seriously impeded structural progress from 1850 to 1876. However a few monumental undertakings belong to this otherwise constructively poor era. The Capitol at Albany, the dome of the Capitol at Washington, Saint Patrick's Cathedral in New York, belong to this period. Due to a variety of causes, the opening up of the West, the great conflagrations

in Boston and Chicago, and the return from Europe of Hunt and Richardson, men thoroughly trained by European study, a revival in architectural spirit and production of the most powerful nature made itself felt throughout the country during the last quarter of the 19th century. With the Romanesque style as his vehicle, Richardson left an artistic imprint upon the nation's art that continues to the present day. Structural verity and dignity of mass mark his works (Trinity Church, Boston; County buildings in Pittsburgh). Hunt, with his great faculty for organization and his thorough founding in the principles of the Renaissance, formally established the Renaissance style. The Marble House, the Breakers at Newport and the Metropolitan Museum of Art in New York exhibit his genius for organized plan and standardization of style. The demand for great commercial buildings in which height was a necessary component on account of the problem of housing multifarious activities in restricted areas, caused the development of new structural form. The introduction of elevators, the invention of various methods of fireproof construction, the inauguration of a skeleton steel fabric and the solution of problems of lighting, heating and sanitation made possible the rearing of great "sky scrapers," the most notable example of which is the Woolworth Building, New York. In spite of the great advances that have been made in the development of architectural science in the United States, no style can be said to have developed that is new and characteristic. Commercial requirements, the demand for speed in design and construction and the experimental conditionings that restrict the modern designer have discouraged the evolution of a typical national style. In works of a public and commercial character the necessity for a co-operative understanding between the architect and the engineer is increasingly felt. It is only when a unified resultant combining the efforts of the architect and the engineer has been achieved — a resultant in which plan and detail shall adequately and truly function with the discoveries of modern science, that a new American style will appear.

LEWIS F. PILCHER.
State Architect of New York.

ARCHITECTURE, Education in. Training.— The ideal architect is an artist who employs structure as his medium of expression,— whose function it is to produce beautiful buildings.

That this ideal is realized by relatively few of those who are called architects in our day is due to the fact that its embodiment under modern conditions involves the correlation of activities of very diverse nature; and few there are who display in just proportion the capacities these diverse activities involve. These may be placed in three great groups, and the architect's training may be considered under three headings, namely, his artistic education, his technical education, his business education.

The student who hopes to be an artist-architect must train himself somewhat as do all artists in all other fields. Yet he cannot with his own hands bring into existence the building his imagination pictures; he is compelled, as no other artist is, to rely upon the work of others in the realization of his artistic creations. Hence it becomes very important for him to gain a very special technical training in order (1) that he may learn how to indicate to his artisan helpers the nature of the work to be done, and (2) that he may become acquainted with the methods proper to these artisans in the accomplishment of their several tasks.

But beyond this the architect who would reach the highest goal should prepare himself for a business career. For unlike other artists he is usually unable to express himself in his chosen medium unless others entrust to him the expenditure of large sums of money. And if he is to be thus trusted he must exhibit executive ability, a knowledge of men and capacity to manage them, and at the same time he must possess unquestioned reliability and business sagacity.

In this connection it may perhaps be well to note that in our time there are not a few men who are counted as successful architects who are really merely good business men working in a special field, men without high artistic ideals or susceptibilities, and who gain such success as they attain by the mere direction of hired designers, and by the careful management of the business of their clients. The education of such men involves only such general training as is required by other business men, with the addition of such studies as will give them a knowledge of the architectural forms current in our time, and such a superficial acquaintance with the principles of architectural design as will enable them to choose as employees designers whose work will satisfy the average taste of their clients.

We need not concern ourselves, however, with business men of this type, for they will not be looked upon as architects by those to follow us unless they combine with their business skill the other qualities demanded of the ideal architect, to the consideration of whose training we may now turn our attention.

Apprentice System.— As is indicated by the etymology of his name, the architect was originally a master workman; one who had arisen from the ranks because he had evinced skill and imagination in guiding the construction of buildings after the methods current in his time, and who through the exercise of this skill and imagination had produced buildings which were looked upon as beautiful by his fellows.

The methods employed by the architects of antiquity are little known to us, yet as the work under their control became more complicated they must have found it necessary to employ assistants who at first were without doubt merely trade apprentices, and from among these the architects of the next generation would most naturally be chosen.

In modern times, as the use of complicated drawings has become more and more important, the architect has found it necessary to use his assistants on special work which does not involve the skill acquired by artisans in construction; and thus the type of man serving as the architect's apprentice has changed. While not an artisan himself he has learned his master's methods, and presently we find men thus trained assuming the function of the architect without any preliminary practice as constructors.

The apprentice system of education for the architect as thus developed was not unlike that adopted in the earlier days in the training of artists in other fields, and with such modifications as are natural in relation to the complexity of modern life it has persisted even to our day in many lands. In England a large proportion of the eminent architects of the day have been educated in this manner, and until within a generation in this country no other system of training for the architect was available.

A similar apprentice system obtained in the training of lawyers and doctors until a late period when special schools of law and medicine became established. The success of these schools called attention to the fact that, from a certain point of view, the architect is as clearly a professional man as the doctor or lawyer, and that the weaknesses in the training of doctors and lawyers under the apprentice system, which had led to the establishment of their special schools, existed also in connection with the study of architecture.

These weaknesses need but to be stated to be apparent to all. Evidently the teaching a busy architect can give to his pupil must vary greatly in quality and amount as the demands of his practice vary. Evidently his teaching is likely to be unsystematic; and it is certain to be biased by his individual taste, a matter which is of importance in relation to certain subjects, to be referred to below, where the broadest catholicity is of importance.

Thus following the example set in other professions, there have been established schools of architecture in which an effort is made to give the student a systematic training which shall not vary in quality and amount from year to year, and which shall avoid the unfortunate influences which are liable to obtain under the apprentice system. It will be generally conceded that the schools as a rule have been reasonably successful in this effort, if general results are considered, if particular instances are not overemphasized.

But the abandonment of the apprentice system of training in the law and medicine carried with it a loss which was generally overlooked. The newer method tended to minimize if not to eliminate the inspiration which comes to the student as the result of contact with the living master in the active practice of his profession. Nowadays students in law and medicine appreciate this loss and are supplementing their school training with practice under the guidance of men of reputation in their special fields.

But the loss to the student of architecture who fails to come under the influence of a practising master can scarcely be overstated. For the artist such an influence is of vital importance; under it he will absorb, as it were, stores of lore peculiar to his art which can never be expressed in the alien words of the lecturer, or upon the pages of a textbook. Fortunately the architects themselves are beginning to see that in one way or another the architectural student must be brought to feel this influence. What was valuable in the apprentice method of education, and has been in many cases lost, must be regained. In no inconsiderable measure it has been regained in the atelier system as developed in the Ecole des Beaux Arts in Paris, and fortunately a distinct movement in the same direction is noted in the later developments of the schools existing in this country.

Granting then that there is a vital something of supreme importance to the architectural student which the school training cannot give, let us ask what he can gain in the schools, with economy of his time and labor, in connection with the training which we have seen to be desirable in the three directions above spoken of, which for convenience we shall treat in reverse order.

Business Training.— The architect's business training cannot be materially advanced in the architectural school. The general education, and the influences which produce the reliable, accurate and farseeing business man, can best be gained quite apart from the school course, in the practising architect's studio. In this connection it may be noted that, while the artistic side of the architect's life must always be first considered, it is easy to underestimate the importance of his business career. The student fresh from the schools too often thinks that he may at once undertake important commissions without the business experience which a long-established practice brings. He will tell you that this can be purchased ready made by the employment of others to attend to this drudgery so repugnant to a man of artistic temperament.

But in this view there lurks a hidden danger to the art of architecture itself. As has been said above, the confidence of the client must be obtained by the man who is to spend the client's money, and if the skilled designer is not one who inspires this confidence the control of great constructions will surely go to men of less artistic ability, and the skilled designer will find himself directed, rather than the director of the work necessary to the embodiment in solid form of the ideas which his imagination creates. Nothing can be more dangerous to progress in architecture as an art than the establishment of a belief that the architect's function ends with the creation of designs on paper; his art product is in the constructed building, and if effective artistic result is to be gained he should actually direct the construction in all particulars and to the very end, and should train himself to assume all the labor and responsibilities this direction involves.

Technical Training.— We may now turn to the consideration of the architect's technical training, which in the first place must result in the mastery of methods of representing his conceptions so that they may be understood by his clients, and comprehended by the workmen who are to be employed to embody them in material form. This means in the main the attainment of skill in technical draughting; and this can very clearly be better and more quickly gained by the concentrated effort possible in a school than in the course of the routine work in an architect's office. The student should be warned, however, that a danger is connected with the attainment of this skill if he comes to look upon his drawings, which are no more than tools of his trade, as works of art in themselves; for these drawings are necessarily on plane surfaces, and if he gives too much thought to their perfection he is liable to over-

look the importance for him as an architect of thinking in solid dimensions.

The general principles governing the representation of details of, and the writing of specifications descriptive of, the work to be done can also be learned in the schools, but little more than these general principles; the student must not hope to gain facility in these important matters without the experience of actual office practice.

Artistic Training.— It is true of all artists, as it is of poets in particular, that they are born and not made; and surely unless all opportunity is lacking the born architect of genius will show his power whatever his training may be. Nevertheless there are certain matters which even the genius must learn by his own often bitter experience, or else from those who have practised his art before him; and these matters may in some particulars be learned most quickly and surely in a school. It will be agreed for instance that each artist should understand well the nature of the medium in which he is to express his measure of genius. The medium of the artist-architect is construction in masonry, in iron and in wood; and a thorough knowledge of the principles of construction is most important to his progress. This knowledge is the ground work of engineering, and clearly can best be gained in a school. In relation to this special study it may be said, on the one hand, that the most thorough training in engineering cannot injure an architect provided it does not take from the time to be given to other equally important matters to be referred to below. On the other hand it must not be forgotten that the architect's function is not merely building as such, but building in a manner that shall stimulate in his fellows the sense of beauty. This molding of constructional forms into shapes which are beautiful is a matter of difficulty which has been attained by architects in the past only through numberless trials, with their failures and successes; through the elimination of the ugly, and the repetition with ever increasing improvement of that which has shown itself to be pleasing. The architect has thus always worked with, and upon, established modes of construction, and he always will; and this distinguishes his work from that of the engineer, whose function it is to devise special modes of structure to meet special structural demands. It is apparent then that the training of the architect in relation to his structural medium differs from that to be given to the engineer, in that the architect does not need to gain more than a thorough understanding of the principles of structure which he is to use in his work, and this does not necessarily involve so prolonged or detailed a study of the sciences as is needful for the engineer.

The Architect as a Designer.— We may now turn to the consideration of what is of the highest importance to the architect, namely, his training as a designer. As we have suggested above, no amount of training can give to a man that measure of genius which constitutes him an artist. None the less the greatest genius will gain much if he learn the lessons taught by the experience of the masters of the past, and the man who is less than a genius were stupid if he did not welcome this teaching. The masters of architecture of the past have left us a record of the forms and relations of parts which after long series of studies and experiments they have found to be most beautiful. This record is not found in written word, but in the great monuments which have been left to us; and the study of these monuments after a certain method constitutes the history of architecture. The student should gain as thorough a knowledge as possible of this history, with especial reference to the vital development of the various greater and lesser styles, giving particular attention to those forms in which the highest perfection has been attained in the past, and making a special study of those forms which appeal to him as most likely to be of service to him under the conditions which surround him. He should also gain a considerable acquaintance with the other arts, especially with those most closely related with architecture, namely, sculpture and painting.

It must be apparent to the reader from what has preceded this that no student should undertake the practice of architecture without facing the fact that he has before him a long road, and a life of arduous efforts. Evidently a large part of the information just referred to can be gained through textbooks and illustrated lectures given in the schools. But as clearly is it important for the architect to study the art products themselves, and this can only be done satisfactorily by travel in the Old World, where the great architectural monuments of the past exist. Where such travel is impossible, he may gain something approximating to it by studying such models of masterpieces of the past as are available in museums, and by the thoughtful use of photographs of existing masterpieces.

Conclusions.— The conclusions reached may now be summarized in a few words. Beyond such general culture as he may be able to gain, the most desirable special training for an architectural student will be given by certain studies which can best be taken in established architectural schools, supplemented by careful observations of monuments of architecture in the course of travel in Europe, and by work in the studio and business office of a skilled practitioner who is a masterful artist.

It were well if life were so ordered that the acquisition of technical facility, and the study of design under a master, could begin in early youth, and continuing could fill the leisure hours of the student while gathering the store of general information which tends to broaden his life; but under existing conditions such an order of work is difficult to arrange.

If choice is to be made among the architectural schools, the one chosen should if possible be one situated in a city where building operations are proceeding on a large scale, and especially one in which design is taught by masters of architecture who are in active practice.

Finally the student would do well who could manage to obtain a position in the draughting room and business office of some architect in active practice during a large proportion of the long school vacations so generally given during the summer season. See PAINTING, EDUCATION IN; SCULPTURE, EDUCATION IN.

HENRY RUTGERS MARSHALL.

ARCHITRAVE, är'kĭ-trāv, in classical architecture and imitations of it, the part of an entablature which rests immediately on the heads of the columns, being the lowest of its three principal divisions; also the molded enrichment on the faces of the jambs and lintels of a doorway or window, this being a part of the entablature carried around the opening and mitred at the upper corners.

ARCHIVES, är'kīvz (Latin *archivum*), a room or building in which are kept the records, charters and other papers belonging to any State, community or family. Very frequently the name is applied to the documents themselves. The archives of the United States are now superintended by the heads of departments.

ARCHIVES, Imperial Russian. This term ("archives") appears in Russian legislation for the first time during the reign of Peter the Great, but the idea of conserving the important acts is very old in Russia, in fact it dates from the earliest period of Russian literacy. Besides the earliest "doskas" (i.e., tablets) which were exchanged between the government of the old Novgorod and the German statesmen in their diplomatic negotiations, there are written acts from the 14th century preserved under the name, 'History of the Russian Civil Code' (I, § 45). Churches and monasteries had, at the time of Peter the Great, well-kept archives not only relating to ecclesiastical matters but also to state affairs: but the great reformer was not satisfied with them and he ordered all the ministries to use the official acts only for three years and after the expiration of that period to place them in the care of an archivist specially appointed by the Emperor. During the reign of Empress Katharine II her archives were left in the custody of a special institution which passed over to the Ministry of Justice. Later, however, that Empress, in the pursuit of her reforms, abolished many institutions and for the custody of documents and acts she ordered two historic archives to be established: one in St. Petersburg and the other in Moscow. The most important archives in the Russian empire are the following: (1) *The Archives of the Imperial Council* which were kept, until 1886, together with the archives of the Senate in the building of the Senate but since that time they have been moved to a magnificent palace in the "Millionaya" street in Petrograd. (2) *The State Archives* which are kept in the Ministry for Foreign Affairs at Petrograd. Those archives contain, among other important diplomatic documents, the secret papers of the Cabinet of Empress Katharine II, as also those relative to the death of Emperor Alexander I and the succession to the throne of Emperor Nikolas I and the documents of the Supreme Court. (3) *The Central Archives of Moscow,* which is the richest storehouse of the most important historic documents in Russia. Established by Peter the Great those archives contain most of the documents of the Russian Embassies abroad and it was impossible for a long time to separate them and transfer them to the Ministry of Foreign Affairs, to which institution they rightly belong. (4) *The Archives of the Holy Synod,* kept in the palace of the Synod, contain several documents previous to 1721 (i.e., two documents from the 16th century, 15 from the 17th century and 70 from the 18th century) relative to important historic events and to the archives of the Synod itself. (5) *The Moscow Archives of the Ministry of Justice,* containing documents relative to the affairs of the State Senate as also some of the oldest records of judicial proceedings from the 13th to the 18th century. (6) In the Ministry of Public Education there are two important historic archives: (a) *Archives of Kief,* established by Imperial decree in 1852 in the building of the University of Saint Vladimir for the purpose of keeping the ancient documents of the governments of Kievskaya, Podolskaya and Volynskaya; (b) *The Central Archives of Vilenskaya,* established at the same time as the Archives of Kief, for the purpose of keeping the documents belonging until that time to the various institutions in the governments: Vilenskaya, Grodnenskaya, Kovenskaya and Minskaya. Besides those there are the following archives of minor importance: (1) *The Central Archives of Vitebskaya;* (2) *The Military-Scientific Archives of the Imperial Russian General Staff;* (3) *The Archives of the Imperial Russian Admiralty;* (4) *Historic Archives of the various governments, etc.*

ARCHIVOLT, är'kĭ-vōlt, in architecture, the ornamental band, often of moldings, on the face of an arch and following its contour.

ARCHONS, är'kŏnz, the highest magistrates in Athens. There was for a long period only one archon, who possessed for life all the power and dignity of a king, and was chosen from the royal race of Codrus. In 752 B.C. a change was introduced, and the tenure of the archonship was restricted to 10 years, the person appointed being still a member of the royal race. In 714 the latter condition was abolished and the archonship thrown open to all the Eupatrids or nobles; and in 683 a still greater change was introduced, the office being now made annual and its functions distributed among a body of nine. The reforms of Solon threw the archonship open to all who possessed a certain amount of property, whether noble by birth or not; and in 477 Aristides made it accessible to all Athenian citizens, without distinction. Until 508 the mode of election was by suffrage of the nobles; election by lot was then introduced, and the person elected had to undergo a scrutiny before the Senate and before the Agora in order to show that his ancestors had been citizens for three generations, and had to swear to obey the laws. The first of the nine archons was called "the archon," and sometimes the Archon Eponymus, because he gave his name to the year in all public records. He had the care of minors and orphans, and had to superintend some of the festivals. The second archon was called the King Archon. Upon him chiefly devolved the care of the religious concerns of the people, in connection with which he had to act as prosecutor of murderers and offenders against religion. The third archon had the name of Polemarch, and was originally entrusted with the superintendence of military matters, though in later times his duties were chiefly confined to the protection and superintendence of the resident aliens. The rest of the archons were called Thesmothetæ, and exercised a general supervision over the laws of the state.

ARCHYTAS, ăr-kī'tăs, an ancient Greek, a native of Tarentum, a famous Pythagorean philosopher, renowned also as a truly wise man, a great mathematician, statesman and general. He was the contemporary of Plato whose life he is reputed to have saved by his influence with Dionysius, and flourished about 400–365 B.C., but the dates of his birth and death are unknown. The invention of the analytic method in mathematics is ascribed to him, as well as the solution of many geometrical and mechanical problems. He constructed various machines and automata, among the most celebrated of which was his flying pigeon. He is credited also with the invention of the pulley. He taught that the earth is a sphere rotating on its axis every 24 hours and that the heavenly bodies move around it. Plato is said to have borrowed some of his opinions from Archytas and Aristotle also is said to have been indebted to him for the idea of his categories and some of his ethical opinions. These opinions, however, appear to depend on spurious writings, the real philosophical remains of Archytas being of inconsiderable value. Horace mentions him in one of his poems (Carm. i, 28) as having been drowned on the coast of Apulia. For his mathematical fragments consult Blass, 'Mélanges Graux' (Paris 1884). The fragments attributed to him which relate to logic, physics and ethics are to be found in Mullach, 'Philosophorum Græcorum Fragmenta' (Vol. I, Paris 1860–81).

ARCIFERA (Latin, *arcus,* bow, + *ferre,* to bear, carry), a division of Anura, including the toads.

ARCIS-SUR-AUBE, är'sę'su'rōb', France, a town of the department of Aube on the river Aube. It is the birthplace of Danton, to whom a monument was erected here in 1886. In 1814 a battle was fought here between Napoleon and the allies in which the latter, with a much superior force, had the advantage and afterward marched to Paris. Pop. 2,841.

ARCO, Austria, a town in the Tyrol, not far from the Lake of Garda, on account of its situation and mild climate a favorite winter resort of invalids. Pop. 3,782.

ARCOLE, är'kō-lā, a village in north Italy, in the province and 15 miles southeast of the town of Verona, on the left bank of the Alpone, celebrated for the battles of 15, 16 and 17 Nov. 1796, fought between the French under Bonaparte and the Austrians in which the latter were defeated with great slaughter.

ARÇON, är-sôṅ, **Jean Claude Eléonore** d', a French military engineer: b. Pontarlier 1733; d. 1 July 1800. He was received into the military school at Mézières, 1754, and in the Seven Years' War he highly distinguished himself, particularly at the defense of Cassel in 1761. In 1780 he invented the floating batteries for the attack of Gibraltar, which, however, were destroyed by the red-hot shot of the besieged. At the invasion of Holland under Dumouriez (in 1793) he took several places, including Breda. He then went into retirement, where he wrote his important 'Considérations Militaires et Politiques sur les Fortifications' (1795).

ARCONA. See ARKONA.

ARCOS DE LA FRONTERA, är'kōs dā lą frōntā'rą, a town in Spain in the province of Cadiz, on the right bank of the Guadalete, which is here crossed by a stone bridge. The sandstone rock on which the town, in form of a bow, is placed, rises 570 feet above the level of the river, which surrounds it on three sides. The houses are mean looking; the streets paved, but generally steep and narrow; and the ancient walls and defenses are in a ruinous state. On the highest part of the rock stands the castle of the dukes of Arcos, partly in ruins. Pop. (1900) 15,700.

ARCOT, ăr-kŏt', the name of two districts and a town of India within the presidency of Madras. North Arcot is an inland district with an area of 7,256 square miles. The country is partly flat and partly mountainous. Pop. 1,817,814. South Arcot lies on the Bay of Bengal, and has two seaports, Cuddalor and Porto Novo. Pop. 1,814,738. The town of Arcot is in North Arcot, on the Palar, about 70 miles west-by-south of Madras. There is a military cantonment three miles distant. The town contains handsome mosques, a Nawab's palace in ruins and the remains of an extensive fort. Arcot played an important part in the wars which resulted in the ascendency of the British in India. It was taken by Clive, 31 Aug. 1751, and heroically defended by him against an overwhelming force under Rajah Sahib. Pop. 11,000.

ARCTIC, a term applied to the North Pole, or the pole raised above our horizon, from the proximity of the constellation of the Bear, in Greek called *arktos.* The Arctic Circle is an imaginary circle on the globe, parallel to the equator, and 23° 28′ distant from the North Pole, from whence its name. This and its opposite, the Antarctic, are called the polar circles. Within these circles the sun does not set during a part of the year, and during a corresponding part does not rise.

ARCTIC CHARR. See TROUT.

ARCTIC EXPLORATION. See POLAR RESEARCH.

ARCTIC REGION, the name given to the region of land and water surrounding the North Pole, reaching on all sides to lat. 66° 32′ N. The Arctic or North Polar Circle touches the northern headlands of Iceland; cuts off the southern and narrowest portion of Greenland; crosses Fox Strait north of Hudson Bay, whence it goes over the American continent to Bering Strait. Thence it runs to Obdorsk at the mouth of the Obi; then, crossing northern Russia, the White Sea and the Scandinavian peninsula, returns to Iceland.

Climate.— The most important facts now ascertained respecting the climate of the Arctic regions are, that the main line of extreme cold extends across the Polar Sea from the meridian of 90° W. to that of 130° E., reaching much farther on the Asiatic than on the American side, so that the winter temperature of Yakutsk (lat. 62° 2′) is 7° F. lower than that of Rensselaer harbor, in Smith Sound (lat. 78° 37′). But the American limit of cold oscillates much less than the Asiatic, the summer temperature at Rensselaer harbor being but 62°, while at Yakutsk it is 95° F. above that of winter. This difference is due to the absorption of summer heat by the comparatively dry plains of Siberia,

while on the North American continent the numerous lakes and inlets moderate the climate throughout the year. To this it may perhaps be added that Greenland, owing to its peculiar constitution and position, is to North America a source of refrigeration which has no counterpart in the eastern continent. This circumstance, and the humid atmosphere maintained by the numerous lakes, somewhat moderates the severity of the cold, but at the same time renders it somewhat more constant.

Arctic Ocean.— In its widest sense that portion of the ocean which extends from the Arctic Circle (lat. 66° 32′ N.) to the North Pole, or more restrictedly from about lat. 70° N. Assuming the former limit, the Arctic Ocean is found entering deeply, in the form of gulfs, bays, etc., into the northern parts of the continents of Europe, Asia and America. The principal of these indentations are the White Sea in Europe; Kara Sea, Gulfs of Obi and Yenisei in Siberia; and Baffin Bay in North America. It is united to the Pacific by Bering Strait, and to the Atlantic by a wide stretch of sea extending from Greenland to Norway. Among the principal islands of the Arctic Ocean are Greenland (at last proved to be an island) and east of Greenland the extensive group known under the name of Spitzbergen, the small island of Jan Mayen, and Iceland. West of Greenland and divided from it by Davis Strait and Baffin Bay there are a considerable number of islands of great size but little interest. North of Europe are the islands of Nova Zembla; and north from these Franz Josef Land, an archipelago as yet imperfectly known. The water of the Arctic Ocean is extremely pure, shells being distinctly visible at a great depth; it also presents rapid transitions of color, chiefly from ultramarine to olive-green, the latter variations of color being produced by myriads of minute animals belonging for the most part to the *Cœlenterata* and *Mollusca* classes. Many have adopted the belief in the existence of an open polar sea about the North Pole. But this belief is not supported by any positive evidence. Ice is nearly constant everywhere between Spitzbergen and the southern point of Greenland. This is called the main north ice. East of Spitzbergen and near Nova Zembla the sea is always beset, if not completely barred, by ice. In Baffin Bay and thence west to Bering Strait numerous expeditions have had a perpetual struggle with ice. The expedition of 1875–76 under Captain Nares, members of which reached a point 30 miles farther north than had ever previously been attained, proceeding by way of Baffin Bay and Smith Sound, found no indications of an open polar sea. On the contrary the explorers found north of 82° 27′ a sea consisting of one unbroken sheet of old ice of immense thickness, which effectually barred the further progress of the vessels, while the ruggedness of the ice rendered it impossible to reach the pole by sledge. Nansen more recently found abundance of ice in the tract of sea crossed by him.

Arctic Current.— It seems certain that a current sets into the polar basin along the coasts of Norway and Lapland. It is probably the effect of prevalent southwest winds, though some call it a branch of the Gulf Stream. There is also a strong current running in at Bering Strait. On the other hand, along the east coast of Greenland and in Baffin Bay the movement is generally south. In the numerous channels between Baffin Bay and Bering Strait the tides are regular but feeble; indeed, it seems possible to trace across Barrow Strait the line of neutralized or no tide, and this, there is reason to suspect, is also the line of comparatively permanent ice.

Minerals.— Valuable minerals, fossils, etc., have been discovered within these Arctic regions. In the archipelago north of the American continent excellent coal frequently occurs. The mineral cryolite is mined in Greenland and carried to the United States. Among other fossils the remains of large saurians are found in the Lias, which extends widely over the northern archipelago, and ammonites collected in abundance prove that in lat. 73° N. there was once a tropical temperature. The group of islands opposite the mouth of the Lena, in lat. 73°, are little more than accumulations of fossil remains carried down by the river and are annually visited for the purpose of digging fossil ivory.

Vegetation.— The plants peculiar to the frigid zone are stunted more by the dry winter winds than by short growing seasons and long winters. The reduction is confined to the limbs, as roots are as long and penetrate as far as in more temperate climates. The vegetation is widely distributed, the species found in North America being practically the same as those found in Europe and Asia, and since trees become more and more scarce as the Pole is approached, the prevalence of the tundra formation is characteristic of the region. In respect to distribution, Arctic plants differ from Alpine plants (q.v.) which, though otherwise similar, especially in the census of cushion and rosette plants and plants with thick-skinned evergreen leaves, include many endemic species. Arctic perennials are noted for the high percentage of species that develop winter-time flowering buds which burst into bloom early in the spring. In the Arctic zone, less than 2,000 species have been described, among them very few trees. These are mostly stunted willows, junipers and birches, and beyond their northern limits flowering plants, grasses, mosses and lichens extend to the most northern land seen by man. Commonest among the flowering species are crowfoots, potentillas, poppies, saxifrages, whitlow grass (*Draba*) and scurvy grass (*Cochlearia*). Thyme and angelica, growing in sheltered spots, are the only perfume-bearers.

The English expedition of 1875–76 found 20 or 30 species of phanerogamous plants between lat. 82° and 83°. From Churchill River on the west side of Hudson Bay (lat. 53°), the line limiting the forest runs constantly to the north of west till it reaches Norton Sound, a little south of Bering Strait, larch and poplar making their appearance as we go west. In Siberia, where the summer heat is greater, woods flourish to a much higher latitude within the Polar Circle. In the Scandinavian peninsula the red pine reaches lat. 69°, the Scotch fir 70°, the birch 71°. Animal life is by no means deficient within the Polar Circle. Species indeed are few, but the individuals are extremely numerous. The proof of this is to be found in the immense number

of skins of fur-bearing animals, eider ducks, seals, walrus, etc., annually supplied to commerce. Recent expeditions have found the usual Arctic quadrupeds and birds as far north as the land extended. How far north the cetaceans reach is doubtful.

Notwithstanding this apparent abundance, the human being has in general a severe struggle for subsistence beyond 64° north latitude, although traces of Eskimos have been found as far north as 81° 52′. The Eskimos who inhabit Greenland and the extreme north of America have a hard life of it, often pressed, and not seldom cut off, by famine. Under their rigorous skies the resources derivable from the surrounding abundance of animal life can support only a handful of men. Even in Siberia, where the reindeer trained to the sledge and the great rivers frozen throughout the winter add so greatly to the facilities of intercourse or emigration, whole communities are frequently cut off by famine or disease. Yet we see Europeans settled under the parallel of 73° at Upernavik in Greenland, of 72° 2′ at Ustyarsk in Siberia, and of 70° 40′ at Hammerfest in Norway, and explorers have wintered far north of this. The settlements in Greenland, northern Siberia, Kamchatka and the Hudson Bay territories are all more or less connected by trade with southern countries, whence they derive their power of endurance; and from the constant care required in order to guard against the consequences of the severe climate it is evident that to man the support of life within the Polar Circle must ever be difficult and precarious. Nevertheless, owing to the abundance of lower animal life, men have visited these regions for centuries to gather the exceedingly rich harvests of furs and oil.

Following are the farthest points of north latitude reached previous to the discovery of the Pole by Peary in 1909.: 1607, Hudson, 80° 23′; 1773, Phipps, 80° 48′; 1806, Scoresby, 81° 12′ 42″; 1827, Parry, 82° 50′; 1874, Meyer (on land), 82°; 1875, Markham and Parr (Nares' expedition), 83° 20′ 26″; 1876, Payer, 83° 7′; 1884, Lockwood, 83° 24′; 1896, Nansen, 86° 14′; 1900, Abruzzi, 86° 33′; 1906, Peary, 87° 6′.

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ARCTURUS, a fixed star of the first magnitude in the constellation of Boötes, and thought by some to be one of the largest of the fixed stars. It has a large proper motion, and is a noticeable object in the northern heavens.

ARCUS SENILIS, a term applied to a white or grayish white rim on the outer edge of the cornea, due to the infiltration of a finely granular hyaline substance, heretofore thought to be a form of fatty degeneration. This is probably not the case, since the infiltration material has no relation to the corneal cells. It is more probably a condition due to changes in the blood vessels of the cornea and is frequently a result of old age. It is a normal phenomenon, however, occurring sometimes in perfectly healthy people, and there is no invariable relationship to fatty degeneration of the blood vessels, heart, or other organ.

ARDAHAN, är'dą-hän', village in the portion of Turkish Armenia ceded in 1878 to Russia, 35 miles northwest of Kars. Its position gives it strategic importance. Its fortress was dismantled by the Russians in the war of 1854–56; in 1878 the Berlin Congress sanctioned the cession to Russia of Ardahan, which had been captured early in the war.

ARDEIDÆ, a family of wading-birds (*Order Ciconiiformes*) including the herons, egrets, night herons, bitterns and some African forms related to the shoe-billed stork (qq.v.). They differ from other families of the order in holding the head drawn by an S-curve of the neck when flying. This family is represented in all the warmer parts of the world.

ARDITI, är-dē'tę, **Luigi,** Italian musician and composer: b. Piedmont, 16 July 1822; d. Hove, Sussex, 1 May 1903. Famous first as a violinist, then as a conductor, he went to London in 1857, and from that year till 1878 was musical director at Her Majesty's Theatre. He has conducted Italian opera and concerts in places as remote from one another as New York and Constantinople; has published the operas 'I Briganti' (1841); and 'La Spia' (1856); and is known as author of much popular music — songs, violin duets and waltzes, such as 'Il Bacio.' He published his 'Reminiscences' in 1896.

ARDMORE, Okla., city and county seat of Carter County, 100 miles south of Oklahoma City, on the Gulf, Colorado & Santa Fé, C., R. I. & Pacific, Saint Louis & San Francisco, and O., N. M. & Pacific railways. The soil is well adapted to fruits, cotton, corn, cereals and forage crops. There are only three months in the year when range cattle must be fed, the climate, abundant rainfall and the fine grass making ideal conditions for stock raising. The production of gas is becoming more and more extensive and important. The Healdton oil field, as reported 8 Aug. 1915, has a total of 311 wells with a production of over 85,000 barrels of oil daily. The gas production of the same field shows 300,000,000 cubic feet a day. Ardmore's industries include a cottonseed oil mill, cotton compress, an ice plant, machine shops, brick plant, mattress factory, electric light and power plant, two planing mills, oil refinery, flouring mill, cotton gins, cigar factory, paint factory, bottling works, paving plant and asphalt brick plant. The machine shops of the Rock Island and Frisco railroads are located here, and Ardmore is the general headquarters of the Oklahoma, New Mexico and Pacific

Railway. The city has three national banks and one State bank, with a combined capitalization, surplus and profits of nearly $4,000,000, an increase of $1,850,000 since 1 Oct. 1915. Ardmore has 12 churches for whites and 4 for negroes. The public school system is especially well organized and intelligently administered. The school population totals about 2,500, the enrolment 2,343, and the average daily attendance 2,048. The high school, costing $150,000, is a handsome structure and the pride of the city. There is also a fine Catholic parish school, and the government school for Indians is located here. The city is under the commission form of government the officials being a mayor and four commissioners. The annual income of the city is $140,000. An artificial lake, covering 300 acres, furnishes Ardmore's water supply. The entire plant, including 1,400 acres of land, is owned by the city. Pop. (1916) 12,500.

ARECA, the designation of a genus of palms, possessing pinnate leaves and a fruit consisting of a one-seeded berry or drupe, with a fibrous rind. To this genus belongs the betel-nut (*A. Catechu*), a native of the East Indies, and cultivated there in many varieties. It is a very beautiful palm, with a slender stem often 40 feet high. Its nuts, called betel-nuts, are rolled into a leaf of the betel-pepper along with a little lime, and are then chewed. The nut contains at least four alkaloids, Arecoline, Arecaïdine, Arecaine and Guvacine, the former alone having known active properties. Arecoline is an active taeniacide and widely used in veterinary practice for the treatment of tapeworms. It is also an active cathartic and mydriatic. In the latter case it is extensively used as a stimulant.

ARECIBO, ä'rā-sē'bō, Porto Rico, important commercial town on the northern coast, facing the Atlantic Ocean, 50 miles west of San Juan. It resembles ordinary Spanish towns in having a plaza, surrounded by the church and other public buildings, in the centre, with streets running from it in right angles, forming regular squares. The buildings are of wood and brick. The harbor is poor, being exposed to the full force of the ocean.

ARENACEOUS ROCKS, the name applied to a petrographic division including loose sands and gravels, sandstone, conglomerate, quartzites and such rocks as are mainly composed of quartz particles. They are of mechanical origin, being derived from disintegration of pre-existing strata and removal and deposition of the materials by wind or water. The grains are generally waterworn and rounded; in some cases, however, they are more or less angular, or rounded and angular grains occur commingled. In older deposits the grains of sand are bound together by silicious, calcareous, argillaceous, or ferruginous cements. It is seldom that a rock is composed of quartzose materials alone; grains or particles of other mineral substances are frequently mingled with the grains of quartz. Silvery flakes of mica are seldom absent; often occurring in layers parallel to the planes of stratification, thus causing the rock to split into thin slabs, and exposing a glittering surface. These are called micaceous sandstones. When grains of feldspar occur, the rock is a feldspathic sandstone. Often large quantities of calcareous matter, either as cement or as distinct grains, occur; and these are called calcareous sandstones. In like manner we have silicious and ferruginous sandstones, when silica and oxide of iron are conspicuously present as cementing or binding materials. Clay and carbonaceous matter, when plentifully diffused through the rock, give rise to argillaceous, carbonaceous and bituminous sandstones. Greensand, or glauconitic sandstone, is a rock containing abundant grains of the dirty greenish mineral called glauconite. Arkose is a sandstone composed of disintegrated granite; volcanic sandstone, trappean sandstone, etc., being composed of disintegrated igneous rocks. The presence of lime can always be detected by the effervescence which takes place on the application of hydrochloric or other acid. A sandstone of homogeneous composition, which may be worked freely in any direction, is called freestone or liver rock. Flagstone is a sandstone capable of being split into thin beds or flags along the planes of deposition. When the sandstone is coarse-grained, it is usually called grit. If it contain, more or less abundantly, grains large enough to be called pebbles, the sandstone is said to be conglomeratic; and if the pebbles or stones be angular, the rock is described as a brecciaform sandstone. Coarse-grained grits and pebbly or conglomeratic sandstones pass into conglomerate or puddingstone, which consists of a mass of various sized water-worn stones. Brecciaform sandstones frequently pass into breccia, an aggregate of angular and sub-angular fragments. Graywacke is an argillaceous sandstone, more or less altered and sometimes semi-crystalline, met with among palæozoic formations. Limestones and shales containing much sand are said to be arenaceous.

AR'ENA'RIA, the name given to a genus of plants of the *Alsinaceæ* or chickweed family. They number upward of 200 species, and are usually low-tufted herbs with white flowers. Many species occur in the United States, and others are found nearly everywhere except in tropical regions.

ARENBERG, or **AREMBERG, August Maria Raimund**, PRINCE, also known as COUNT LA MARCK, Belgian soldier and writer, brother of the Duke of Arenberg: b. Brussels, 23 Aug. 1753; d. there, 26 Sept. 1833. Began his career as a cadet in the military service of the Duke Charles von Lothringen. Served under the French in India and against the English in America from 1780 to 1782. During the French Revolution he became intimately associated with the famous leader, Mirabeau. His chief literary work, of much value for the light it throws on French history during the Revolution, is 'Correspondance entre le comte de Mirabeau et le comte de La Marck' (edited by Vacourt, 2 vols., Brussels 1851).

ARENBERG, or **AREMBERG, Leopold Philipp Karl Joseph, Duke of**, Austrian soldier: b. Brussels, Belgium, 1690; d. Löwen 1754. He began his career as a soldier as a mere child and at the age of 16 was already colonel. Gaining the favor of Archduke Charles, who later became Emperor Charles VI, he served him as Councillor of State. In 1709 he became grand bailiff of Hainault. In 1716 he went to Hungary and served under Prince Eugene and especially distinguished

himself at the battle of Belgrade. Subsequently he attained the rank of field marshal and was commander-in-chief of the Imperial forces in the Netherlands and as such commanded the operations at the battle of Dettingen. In 1747 he became president of the commission governing the Netherlands. Aside from his military interests, he was an ardent patron of learning and a close friend and patron of Jean Jacques Rousseau. He maintained an intimate correspondence with Frederick the Great and Voltaire. Consult Gachard (in the 'Biographie Nationale,' published by the Royal Academy of Belgium).

ARENBERG, or **AREMBERG,** formerly a German duchy, between Jülich and Cologne, now incorporated in the Prussian administrative district of Coblenz. Its rulers played a part of some importance in German history of the 12th century, but in 1280 the male line died out. One of the female descendants married the Count de La Marck, the younger of whose two sons became the Lord of Aremberg. In 1547 the male line again died out, but the heiress married into the Ligne family and her husband was made a count of the empire by Charles V. Because of the services rendered by him and his sons to the Emperor, his title was raised to that of duke. See ARENBERG, DUKE OF.

ARENDAL, Norway, a town at the mouth of the Nid Elf, in the Bay of Christiania. It is sometimes called "the little Venice," because of the fact that many of its houses are built over the water on piles. The harbor is well protected by the island of Tromö, which has favored the development of the town as a commercial port. The principal exports are timber, wood pulp and iron ore from the mines nearby. Pop. (1910) 10,315.

ARENDT, ä'rent, **Otto,** German economist: b. Berlin, 10 Oct. 1854. He studied, first law, then economics, in the universities of Leipzig and Freiburg. In 1882 he was one of the founders of a society for the promotion of a movement for international bimetallism, which evolved into a political party, of which he was the chief. In 1885 he was elected to the Prussian House of Representatives. In 1888 he became editor of the *Deutsches Wochenblatt,* a publication that advocated a strong colonial policy. His works are 'Die vertragsmässige Doppelwährung' (1880); 'Leitfaden der Währungsfrage' (17th ed., 1895); 'Die Ursache der Silberentwertung' (1899); 'Die parlamentarischen Studienreisen nach West- und Ost-Afrika' (1906); 'Geld, Bank, Börse' (1907).

ARENDT, Rudolf, German chemist: b. Frankfurt-on-the-Oder 1828; d. 1902. After graduating from the University of Leipzig he became a teacher in a business college in his native town. Later he was editor of the *Chemisches Centralblatt,* a position he held for many years. His chief works on chemistry are 'Technik der Experimental Chemie' (2 vols., 1881); 'Anschauungsunterricht in der Naturlehre' (4th ed., 1886); 'Leitfaden für den Unterricht in der Chemie' (7th ed., 1899); 'Grundzüge der Chemie' (8th ed., 1903).

ARÈNE, ą'ren', **Paul Auguste,** French poet: b. Sisteron 1843; d. Antibes 1896. He was successively director of the Lyceum at Marseilles and the Lyceum at Vanves. In 1865 he attracted wide attention by the production of a one-act comedy, in verse, 'Pierrot héritier.' His other works are dramas, 'Jean des figues' (1870); 'Les comédiens errants' (1873); 'Le duel aux lanternes' (1875); prose fiction, 'Au bon soleil' (1879); 'Le canot des six capitaines' (1888); descriptive travel, 'Vingt jours en Tunisie' (1884). Consult Armand Silvestre in preface to 'Poésies' (Paris 1900); 'Lorenz Petry' (Halle 1910).

ARENG PALM, the name of a palm, *Arenga saccharifera.* It grows wild in the islands of southern Asia and is cultivated in India. The sap furnishes "arenga sugar" and the black fibre of the leaf bases, known as gomuta fibre, is used in filters and for calking ships.

ARENSKI, ą-rĕn'skē, **Anton Stepanowitch,** Russian composer: b. Novgorod, 30 July 1861; d. Tarioki, Finland, 25 Feb. 1906. He graduated 1882 from the Conservatory at St. Petersburg, where he had been a pupil of Rimski-Korsakoff. The following year he was appointed professor of composition at the Imperial Conservatory in Moscow, where he first began to attract general attention. In 1895 he succeeded Balakireff as conductor of the Imperial Court chorus. His most noted compositions are operas, 'Dream on the Volga' (1892); 'Raphael' (1894); 'Nala and Damayanti' (1899); orchestral music, two symphonies; concerto for piano; concerto for the violin; a fantasia for piano and orchestra; chamber music, string quartets, trios, quintets. His written works are 'Treatise on Harmony'; 'Handbook of Musical Forms.'

ARENTS, ä'rĕnts, **Albert,** German-American metallurgist: b. Klausthal, Germany, 14 March 1840. After studying mining engineering in Berlin he came to America, in 1865, and went to the lead mines in Hampton County, Mass. Later he went west, where he acted as engineer for various mining enterprises. He is chiefly known for his inventions, among which is a siphon tap for lead blast furnaces.

ARENTZEN, ä'rĕntz-ĕn, **Kristian August Emil,** Danish poet: b. Copenhagen, 10 Nov. 1823; d. there January 1900. After making a tour of Iceland and Italy, he became professor of æsthetics at the University of Copenhagen. In 1872 he was granted a pension by the government to enable him to devote himself exclusively to his literary work. Among his works are dramas, 'Gunlög Ormetunge' (1852); 'Knud den Hellige' (1853); a volume of collected poems, 'Digte' (1854), republished as 'Ny Dygtsamling' (1867); a critical work, 'Baggesen og Ohlenschläger' (8 vols., 1878).

AREOIS, ä'rā-ō'ēz, a society of natives of Tahiti, of a semi-religious nature. The nearest parallel to the character of this peculiar native institution is found in the orgies of some of the Greek mysteries of antiquity. The members exalted the sex pleasures, the women being compelled by the oaths of initiation to renounce all desire for maternity. Dancing, singing and the representation of stirring events of the past, by a sort of pageantry, were also a part of their practices.

AREOMETER. See HYDROMETER.

AREOPAGITICA, the best-known of the prose works of John Milton. The full title runs 'Areopagitica: a Speech of Mr. John Milton for the Liberty of Unlicenc'd Printing, to the Parliament of England.' These words recall Isocrates and Mars Hill, and illustrate Milton's erudition, as well as his predilection for what he terms "the old and elegant humanity of Greece." They indicate also that his plea was made, not so much for full liberty of the press and toleration of opinion — although splendidly high-minded and liberal he was not prepared to tolerate "Popery and open superstition" — as for the abolition of that system of licensing books and tracts, the stupidity and inconvenience of which he could expose and denounce from personal experience and with weighty arguments drawn from an extraordinarily wide reading of history and literature.

The tract, for it is a speech in form only, appeared in November 1644 after Milton had caused to be printed without license two pamphlets on divorce, which had occasioned much scandal and had involved him, not seriously as it turned out, in trouble with the House of Commons. It is needless to add that the 'Areopagitica' was itself unlicensed, and it is pleasant to know that although shortly after it was published there seemed to be a chance that the House of Lords would call its author to account, he did not suffer for his boldness (consult for full details Masson, Vol. III, pp. 262–97, and the most elaborate edition, that of T. Holt White, 1819).

Its subject matter still possessing widespread interest and great importance, and its style being more equable and less cumbrous than that of Milton's other prose works, the 'Areopagitica' has naturally surpassed them in permanent influence and, if the word may be employed in connection with Milton, in popularity. More wonderfully eloquent passages may be found in other tracts, as well as a larger number of indispensable autobiographical details, but Milton the "lord of language," as Tennyson called Virgil, and Milton the noble patriot and man are perhaps nowhere else in the prose works so accessible to the latter-day reader. How Milton towers above other mortals is well perceived by anyone who examines the pamphlets on the freedom of the press published in some quantity two generations later, to which such authors as Tindal and Defoe contributed; but one need not search outside the 'Areopagitica' itself for proofs of Milton's superiority as a man and a writer. Take for example the famous passages on killing a good book, on "a fugitive and cloistered Virtue," and "our sage and serious Poet *Spencer*," on the essential intelligence of the people,— the roots of democracy were in this intellectual aristocrat — on the visit to Galileo, on the dismemberment of "the Virgin Truth," on England, "a nation not slow and dull," which later he sees "as an Eagle muing her mighty youth." Eloquence and personal dignity and learning are here in full measure, but the 'Areopagitica' is also notably practical, and its sarcasm is rendered more than usually effective and even agreeable by a vein of genuine though grim humor, which perhaps only once is unintelligible save to the student of Latin. Barring the almost ludicrous depreciation of Aristophanes, the tract is but slightly amenable to hostile criticism, and one is not surprised to find that two poets, Thomson of 'The Seasons' and Lowell, have written introductions to it, and that on the eve of the French Revolution Mirabeau appears to have abridged it in 'Sur la Liberté de la Presse, Imitée de l'Anglois de Milton.'

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AREOPAGUS, the designation of the oldest Athenian court of justice. It obtained its name from its place of meeting, on the Hill of Ares (Mars), near the citadel. Its establishment is ascribed by some to Cecrops, by others to Solon; from the latter, however, it seems to have only received a better constitution and more important privileges, and it is probable that it existed from very remote times. Of how many members it consisted is not now known. A seat in it was held for life. The members were men who in their former capacity of archons had rendered themselves worthy of this honor by the honest and diligent execution of their office, and whose character and conduct had been subjected to a particular examination. Aristides called the Areopagus the most sacred tribunal of Greece, and Demosthenes assures us that they never passed a sentence in which both parties did not concur. Crimes tried before the tribunal were wilful murder, poisoning, robbery, arson, dissoluteness of morals and innovations in the state and in religion; at the same time it took care of helpless orphans. The other states of Greece sometimes submitted their disputes to the judgment of the Areopagus. Its meetings were held in the open air and in the night time. After the investigation of a case the votes were collected. In the time of Pericles its political influence was materially lessened, but it continued a much venerated assemblage, and in Roman times its decisions still commanded respect. The Apostle Paul is sometimes thought to have been brought before this ancient court, but it is more likely that his famous address on Mars Hill was before an assemblage of philosophers there. Consult Botsford, 'The Athenian Constitution' (1893); Busolt, 'Handbuch' (Nördlingen 1887); Philippi, 'Areopag und Epheten' (Berlin 1874); Schömann, 'Griechische Alterthümer' (ib. 1897); Meier and Schömann, 'Der attische Prozess' (Berlin 1883–87).

AREQUIPA, ä'rā-kē'pa, Peru, city and capital of a department of the same name. It is situated in a fertile valley 200 miles south of Cuzco, at the height of 7,550 feet above the sea. Prior to the earthquake of 13 Aug. 1868, which did not leave a single house habitable, it was one of the best-built towns of South America. Beside it rise lofty mountains, El Misti, Omati, Ubinas and Pichu Pichu. It contains a cathedral, university, hospital, nunneries, convents, etc. Near at hand Harvard University has an observatory, at an altitude of over 8,000 feet. It is subject to frequent earthquakes, but this evil seems to be overbalanced by the mildness of the climate and the beauty and fertility of portions of the country round about. Islay was formerly the provincial port, but it has been superseded by the neighboring Mollendo, connected by railway with Arequipa and the highlands beyond. The industrial products of

the city are varied, including cotton and woolen textiles, leather, gold- and silver-smiths' work, etc. The engineering shops of the Southern Railway are at a short distance from the central plaza. The inhabitants number about 35,000. See the description of the department AREQUIPA.

AREQUIPA, Peru, a coast department estimated to contain 21,947 square miles; bounded on the north by Ica, Ayacucho and Cuzco; on the east by Puno and Moquegua; and by the Pacific on the southwest. Its most important port is Mollendo, which the Southern Railway of Peru connects first with the capital of the department and then with Cuzco, Puno and other cities or towns of the highlands. The provinces are Arequipa (capital Arequipa), Cailloma (capital Cailloma), Camaná (capital Camaná), Castilla (capital Aplao), Condesuyos (capital Chuquibamba), Islay (capital Mollendo) and La Union (capital Cotahuasi). Olives, grapes, sugar and cotton are grown in the valleys, and the uplands produce cereals, potatoes, etc. Minerals found in the department are gold, silver, copper, lead, coal, sulphur, manganese, rock-salt, borax, gypsum and kaolin clay. In the Desert of Islay, through which runs the above-mentioned railway, are the migrating, crescent-shaped sand dunes, remarkable for beauty of form and the impressiveness of the landscape in which they are seen. Pop. 172,000.

ARETÆ'US, physician of ancient Greece: b. in Cappadocia. He lived in Rome during the latter half of the 1st century and the beginning of the 2d century A.D. Next to Hippocrates he has been considered the best physician of his period. He left behind a monumental work, written in Ionic, the first four books of which are devoted to the diagnosis of acute and chronic diseases; the latter four volumes treat of their cure. The finest edition of the original is the one edited by J. Wigan (Oxford 1723). An excellent German translation has also been published (Vienna 1790–1802). The best English translation is by T. F. Reynolds (London 1837).

ARETAS, King of the Nabatæan Arabs. Originally his name was Æneas but he assumed the name Aretas. He gained the city of Damascus, probably as a gift from Caligula, about the time Paul the Apostle was there. Aretas attacked and defeated Herod Antipas about 28 A.D., partly because of the divorce of his daughter by Herod. He lived until about 40 A.D. Under him the kingdom of Nabatæa stretched from the Euphrates to the Red Sea. By the year 106 the whole kingdom was annexed by the Romans and was known as the province of Arabia. Damascus had been regained as early as 62.

ARETHAS, Byzantine theological writer and scholar: b. Patræ about 860. He became archbishop of Cæsarea under Emperor Leo VI and as such was next in rank to the patriarch of Constantinople. He must have lived to a good old age, as we have a manuscript letter of his to the Emperor Romanus. He was a defender of Orthodoxy as it was understood by Photius. He was the author of a Greek commentary on the Apocalypse, avowedly based on that of Andrew, his predecessor in the archbishopric. In spite of its author's modest estimate, Arethas' work is by no means a slavish compilation; it contains additions from other sources and especial care has been taken in verifying the references. His interest extended beyond theological literature. He annotated the margins of his classical texts with numerous scholia, and had several manuscripts copied at his own expense, among them the 'Codex Clarkianus' of Plato (brought to England from the monastery of Saint John in Patmos) and the Dorvilian manuscript of Euclid, now at Oxford. Text of his commentary is in Migne, 'Patrologia Græca' (Vol. CVI, pp. 487–786) and Cramer, 'Catena Græcorum patrum in Novum Testamentum' (Vol. VIII, pp. 176–582, Oxford 1844). Consult Gebhardt, O., and Harnack, A., 'Texte und Untersuchungen zur Geschichte der altchristlichen Litt. (Vol. I, pp. 36–46, 1882), and 'Vita Euthymii' (ed. C. E. de Boor, 1888); Wace, H., 'Dictionary of Christian Biography' (Vol. I); Krumbacher, C., 'Geschichte der byzantinischen Litteratur' (1897).

ARETHUSA. See ALPHEUS.

ARETINO, ä'rā-tē'nō, **Carlo,** properly CARLO MARSUPPINI, Italian scholar: b. Arezzo 1399; d. 1453. He obtained a finished classical education at Florence, being at one time a pupil of Giovanni da Ravenna and Manuel Chrysoloras. The profound knowledge of the classic writers he showed in his lectures won him immediate fame. He finally became first apostolic secretary, then, in 1444, was appointed chancellor of the republic of Florence. He translated the first book of the 'Iliad' and the 'Batrachomyomachia' into Latin. His tomb in the Church of Santa Croce, at Florence, is one of the finest examples of the sculptural art of the Renaissance yet to be seen in that city. Consult Nisard, 'Les gladiateurs de la république des lettres aux XVe, XVIe et XVIIe siècles' (Paris 1860).

ARETINO, Guido, or **GUIDO D'AREZZO,** Benedictine monk and reformer of music: b. probably near Paris, about 995; d. probably at Avellano, 1050. For a long time it was believed that he was born at Arezzo but Dom Germain Morin found evidence that Guido had received his education at the monastery of Saint Maur des Fossés, near Paris, a fact which adds to the probability of his having been born near Paris. He is supposed to have first reduced the science of music to a fixed system and to have been the inventor of the monosyllables of the *Solfeggio — ut, re, mi, fa, sol, la,* drawn from the words of a Latin hymn. The monosyllable *si,* for the seventh of the scale, is a later invention. The syllables *ut, re, mi,* etc., are taken from a Latin hymn in honor of Saint John, composed in 770:

Ut queant laxis — *Re*-sonare fibris
Mi-ra gestorum — *Fa*-muli tuorum.
Sol-ve polluti — *La*-bii reatum.

It is narrated that on one occasion, while chanting this hymn, Guido noticed the gradual and regularly ascending tones of the first syllables of each hemistich in the three verses given above and promptly systematized and fitted these to his system of solfeggio. The fame of this system spread afar and Guido was subjected to much jealousy and ill-will both in his own and other monasteries, but

also attracted the favorable attention of Pope John XIX, who invited him to Rome. Guido was well received at the papal court, and taught the Pope his new system, which the latter helped to spread. In 1029 Guido was appointed prior of Avellano, where he probably remained until his death. The introduction of the four-line staff is ascribed to him. Guido wrote much in explanation of his musical doctrines, of which the most important are the 'Micrologus' and the 'Argumentum Novi Cantus Inveniendi.' Consult Michael, 'Geschichte des deutschen Volkes vom 13 Jahrhundert bis zum Ausgang des Mittelalters' (Vol. IV. p. 338, 1906).

ARETINO, Pietro, Italian writer and poet: b. Arezzo, 20 April 1492; d. Venice, 21 Oct. 1557. Aretino's life and character find almost a complete parallel in the career of the better known French profligate poet and criminal François Villon, of whom he was a contemporary. He was the natural son of one Luigi Bacci, a gentleman of the town. Early in life he went to Perugia, where he worked as a bookbinder. In 1517 he went to Rome, where he obtained a minor position at the Vatican. Here he began attracting attention by his verse and even obtained the favor of Pope Leo X and Cardinal Giulio de Medici, but soon lost it through the licentious character of some sonnets he wrote. Finally, in 1527, he went to Venice, where he gained powerful and influential friends, and there he spent most of his later life. Among his patrons were Francis I and Charles V, who made him rich gifts of jewelry and even allowed him pensions, all of which enabled him to live a luxurious life. Aretino's talents were most remarkable in the production of satirical verse, which he could make so biting that at one time he was feared by most of the public men of Italy. On the strength of this fear he worked to his own advantage, exercising a sort of blackmail over prominent personages. Aside from his poetry he wrote some comedies and one tragedy, the latter, 'Orazio,' showing a fair measure of talent. Of his comedies only 'Cortigiana' and 'Talanta' are of any merit. Consult Van Dyke, 'Renascence Portraits' (New York 1905).

AREZZO, ą-rĕt'-sō, Italy, city and capital of a province of the same name in Tuscany. In ancient times it was known as Arretium, when it was one of the most prosperous cities of Italy. During the 3d and 4th centuries B.C. it was bitterly opposed to Rome, but on the occasion of Hannibal's invasion it supported the Romans. Later, when the Gauls began invading Italy it sought the support of the Romans. At that time it was famous for its pottery. It was the birthplace of a number of famous men, among them Petrarch, Leonardo Aretino, the historian, Cesalpino, the botanist, Pope Julius II and Vascari. It is still a city of some attractions, having broad, well-paved streets, a museum, a library, several convents and a cathedral built in the 13th century. It is surrounded by a fertile country producing grain, olives, wines and fruits. In the city are located a number of industrial plants in which are manufactured silk fabrics, leather goods and textiles. Pop. (1911) 48,170.

ARGALL, Sir Samuel, navigator and American colonial official: b. Walthamstow, Essex, England, about 1580; d. 24 Jan. 1626. He was a type of the founders of English colonial dominion — energetic, resourceful and masterful; his further repute as a sort of unprincipled buccaneer and tyrant is due to sentiment and partisanship. In May 1609, he was sent with a small barque to the new settlement at Jamestown, Va., to trade and fish on behoof of the owner. He seems to have found a shorter route than usual, and soon established a reputation for unprecedentedly quick passages. The next year he took out Lord Delawarr to Jamestown, arriving just in time to prevent the entire colony, with the governor, Sir Thomas Dale, leaving for Newfoundland to avoid starvation. He was sent to the Bermudas for swine to replace those the colonists had eaten, but was driven by storms to Cape Cod where he found good fishing and returned in August; established a corn trade with the Indians above Jamestown, and early in 1611 returned to England with Delawarr, whose health was bad. In September 1621, he was again at Jamestown after the then swift passage of 51 days, and the rest of the year he and Dale spent in corn hunting among the Indians. Powhatan had a number of English prisoners in his hands and a quantity of weapons and implements, and Argall hearing that the chieftain's daughter Pocahontas was with her uncle «Powtownec» (Potomac), had the happy thought of securing her to exchange against them, a feat accomplished by threats and the offer of a copper kettle to her uncle. The stock denunciation of him for this «nefarious treachery» is best answered by the fact that no one was harmed, all parties were benefited and a most desirable aim was achieved. Pocahontas herself considered it a piece of rare good fortune, would not leave the whites and soon after married one of them, while the prisoners were released and peace restored to the colony. Argall handed her over to Sir Thomas Gates and explored the east shore of Chesapeake Bay, fishing and trading. Later in the year he was sent with a vessel of 14 guns to destroy the French settlements on the north coast, regarded as infringing on the Virginia patent. He captured Mount Desert, Saint Croix and Port Royal (N. S.), carried off the settlers as prisoners to Jamestown, and on the way forced the commandant at New Amsterdam to recognize English suzerainty by hauling down the Dutch flag and running up the English. In 1614 he sailed for England, and was put on his defense for these high-handed acts, but completely justified himself. In May 1617, he was made deputy governor of Virginia, and remained two years in a broil with part of the citizens, but justified by others. He was accused of illegal trade with the West Indies, and repeatedly ordered to return to England for trial, a command which he ignored for a time, possibly in reliance on the Earl of Warwick, who is supposed to have financed and shared his ventures. In 1620 he served against the Algerine pirates with a 24-gun merchant vessel, under Sir Robert Mansell. He was knighted in 1622. In 1625 he was admiral of a squadron cruising after a hostile Dunkirk fleet, and took some prizes. On 3 October of that year he embarked with the squadron in the expedition against Cadiz under Lord Wimbledon, with Lord Essex on board as vice-admiral and com-

mander of land forces; Argall's flagship was the *Swiftsure*. He reported the fortress too strong to be taken without a siege, the merchant vessels were ill supplied and unpaid, and after waiting till December for relief from Charles I they went home. Argall died the next month, it was said from a broken heart because the captain of the *Swiftsure* was "very backward and cross" to him. (Argall's own narrative comes down to 12 May 1613).

ARGAND, är'gän, **Aimé**, Swiss-Italian inventor: b. Geneva 1775; d. London, 24 Oct. 1803. He is principally known as the inventor of the lamp burner which still bears his name, though he was also a mathematician of some note. The idea of the burner, the steadying of the flame by a current of air coming up through a hollow centre, was stolen from him by a French pharmacist, Quinquet, when he, Argand, became involved in difficulties during the French Revolution. Brooding over this caused him to lose his reason. He was also the inventor of a pneumatic machine of some value. He wrote 'Découverte des lampes à courant d'air et à cylindre' (1785).

ARGELANDER, är'gĕ-län'dĕr, **Friedrich Wilhelm August**, German astronomer: b. Memel, Prussia, 22 March 1799; d. Bonn, 17 Feb. 1875. His first interests as a student at Königsberg were in economics, but after attending several lectures on astronomy by Bessel he decided to devote himself to astronomy. In 1820 he was made Bessel's assistant in the Königsberg Observatory; three years later he became astronomer at the observatory in Abo, Finland. It was here that he began those observations which later made him one of the most noted astronomers of his time, though later the destruction of the observatory by a fire compelled him to continue his work at Helsingfors. In 1837 he became professor of astronomy at Bonn. Argelander has added much to the knowledge of the progressive motion through space of the solar system. His chief work is the 'Atlas des nördlichen gestirnten Himmels' (Bonn 1857).

ARGENIS, a romance written in Latin by John Barclay, published in 1621. Like 'Gulliver's Travels,' it is really a commentary on current historical events, thinly veneered by its fictional form. But even as a piece of fiction it has some merits, for Cowper said of it that it was "the most amusing romance that was ever written." Fénelon's 'Télémaque' is said to have been suggested by it. Cardinal Richelieu also prized it very highly and is supposed to have been inspired in his diplomacy by its suggestive character. The characters in the romance represent Henry IV, Queen Elizabeth and Philip II of Spain.

ARGENSOLA, Bartolomé Leonardo de, Spanish poet: b. Barbastro, Aragon, 26 Aug. 1562; d. Saragossa, 26 Feb. 1631. Until 1610 he lived in Salamanca, when he accompanied the Count de Lemos to Naples (see ARGENSOLA, LUPERCIO), together with his brother. On the death of the latter, in 1613, he returned to Spain, where he succeeded to his brother's position as historiographer of Aragon. Here he took up his brother's unfinished work, a continuation of Zurita's 'Annals of Aragon.' The collected poems of the two brothers were published by Lupercio's son after their death, under the title 'Rimas' (1634). The best modern edition of their works is that which was edited by the Count de la Viñaza and in the 'Colección de escritores castellanos' (1889). In this also is included two plays by Lupercio, 'Isabela' and 'Alejandra.'

ARGENSOLA, Lupercio Leonardo de, Spanish poet: b. Barbastro, Aragon, 14 Dec. 1559; d. Naples, March 1613. He and his younger brother, Bartolomé (q.v.), have sometimes been called the "Spanish Horaces." Both brothers enjoyed the special protection and favor of Maria, widow of Emperor Maximilian II of Austria. After having served her as secretary for some time, Lupercio was appointed official historian of Aragon by Philip III. In 1610 he accompanied the Spanish viceroy, Count de Lemos, to Naples, where he filled the position of State Secretary until his death three years later. Before leaving Spain he had written for the Count de Lemos, who was then president of the Indian Council, 'Conquista de las Islas Molucas' (1609). Consult Crawford, 'Notes on the Tragedies of Lupercio Leonardo de Argensola' (in the *Romanic Review*, Vol. IV, 1913).

ARGENSON, Marc Pierre de Voyer, COUNT D', French statesman, brother of René Louis de Voyer d'Argenson (q.v.): b. Paris, 16 Aug. 1696; d. there, 22 Aug. 1764. At the age of 24 he was lieutenant-general of the provincial gendarmerie. In 1742 he succeeded de Breteuil in the war office and after the death of Cardinal Fleury, in 1743, found himself supreme chief of the French war operations. To his energy and administrative ability is due in no small measure the final success of the French arms against the Austrians, who had threatened the very existence of the nation and had already invaded Alsace and Lorraine. After the favorable termination of the war, with the Treaty of Aix-la-Chapelle in 1748, Argenson continued his work in the war office with a general reorganization of the French armies, one of his reforms being the establishment of the Ecole Militaire in 1751. How he stood in the world of arts and letters may be judged from the fact that Voltaire wrote his 'Siècle de Louis XIV' largely from material supplied him by Argenson, and the famous 'Encyclopédie' was dedicated to him by its illustrious editors, Diderot and D'Alembert.

ARGENSON, Marc René, MARQUIS D', French statesman: b. Venice, Italy, 4 Nov. 1652; d. Paris, 8 May 1721. He was for some years chief of the Paris gendarmerie, but in 1718 was made Keeper of the Seal and, two years later, Minister of State. But the mad schemes for the financial regeneration of the treasury which John Law was then involving the king in caused Argenson soon to resign. He was a very generous patron of letters and arts and was made a member of the Academy.

ARGENSON, René Louis de Voyer, MARQUIS D', French writer: b. 18 Oct. 1694; d. 10 Jan. 1757. While Minister of Foreign Affairs under Louis XV, from 1744 to 1747, he foiled the intrigues of the Spanish Court in certain diplomatic negotiations of a delicate nature. But Spanish influence still remained strong enough in the French Court to cause his resignation, whereupon he retired to private life

and followed the life of a student and a man of letters. He was a close friend of Voltaire. His chief works are 'Considérations sur le gouvernement ancien et présent de la France' (1764); his 'Memoirs' (9 vols., 1861–67); 'La France au milieu du XVIII• siècle' (1898). Consult Ogle, 'The Marquis d'Argenson' (1893).

ARGENTA, är-gen'tą, Ark., city in Pulaski County, on the Arkansas River, opposite Little Rock and on the Saint Louis Southwestern, the Saint Louis, Iron Mountain and Southern and the Chicago, Rock Island and Pacific railroads. It is in the centre of a fertile agricultural region producing corn and other grains. Natural gas is available and is utilized by a number of manufacturing plants, including extensive railroad repair shops, four cotton oil mills and a boiler and iron works. The municipality owns and operates its own electric lighting plant. Pop. (1910) 11,138.

ARGENTEUIL, är'zhän-tē'-y', France, a town on the right bank of the Seine, seven miles northwest of Paris in the department of Seine-et-Oise. It supplies much wine, fruit and vegetables for the Parisian market. Excellent asparagus is produced in the vicinity. Alcohol, files, pasteboard, and watches are manufactured. The famous Héloïse was abbess of its now ruined priory from 1120. This priory was founded by Charlemagne in the 7th century, and his daughter Theodada was its abbess. The town grew up about the priory. Pop. (1911) 24,282.

ARGENTINA, OR THE ARGENTINE REPUBLIC. A federal republic, the second largest of South America, situated in the southern extremity of South America, between the 22d and 55th parallels of south latitude and between the meridians of 54° 20′ and 73° 30′ of longitude west of Greenwich, the greater part of the territory thus lying within the temperate zone. It is bounded on the north by Bolivia, Paraguay and Brazil, on the east by Uruguay and on the west by Chile. Its eastern boundary is composed entirely of maritime or fluvial coasts, in direct contact with the world's commerce by means of numerous ports of easy access. Its area is 1,153,119 square miles. The history and political and industrial development of Argentina are treated under the following headings:

1. Physiography.
2. Political Divisions, Population and Immigration.
3. History
4. Government.
5. Education.
6. Agriculture.
7. Commerce.
8. Mining and Manufacturing Industries.
9. Banking and Finance.
10. National Wealth.
11. Transportation.
12. Army and Navy.

1. PHYSIOGRAPHY. 1. A notable characteristic is found in the Pampas which cover more than three-fourths of the country. The plains, however, can be further divided into four great sections: (1) The Chaco plains, between the rivers Pilcomayo, Paraná, and Salado del Norte, comprising the eastern portion of Jujuy, Salta, and Tucuman, the territory of the Chaco, part of the province of Santiago del Estero and the north of Santa Fé; all of it being warm, thickly wooded and rich in excellent timber. Here preference is given to the cultivation of sugar-cane, cotton-growing and quebracho-cutting. (2) The pampas properly so called, most notable on account of the uniformity of level and the almost total absence of trees, but covered by excellent pastures in which gramineous grasses preponderate. This region is gradually being devoted to agricultural purposes such as the cultivation of wheat, linseed and corn, after having first served for cattle-feeding. (3) Between the last two regions the saline plains extend from the range of Aconquija to that of Córdoba and reach to the Salado River. This region derives its name from the great amount of salt covering the soil. (4) The southern plains, south of the 38th parallel, and popularly known as Patagonia, comprise the territories of Rio Negro, Chubut, Santa Cruz and Tierra del Fuego, sloping down from the Andes in three successive inclines. "Stock farming, especially sheep farming, dominates in this field, yielding large profits," says Mr. Marrion Wilcox, an American expert on Latin-American countries, adding: "New port works, extension of the sheep industry, plans for rendering navigable the Patagonian rivers, the production of minerals in the Cordillera and the Far South — all these forms of activity show that in a commercial sense Patagonia is to be regarded as a land of the future." (In *Bulletin of the American Geographical Society*, Vol. XLII, No. 12, pp. 903, seq.).

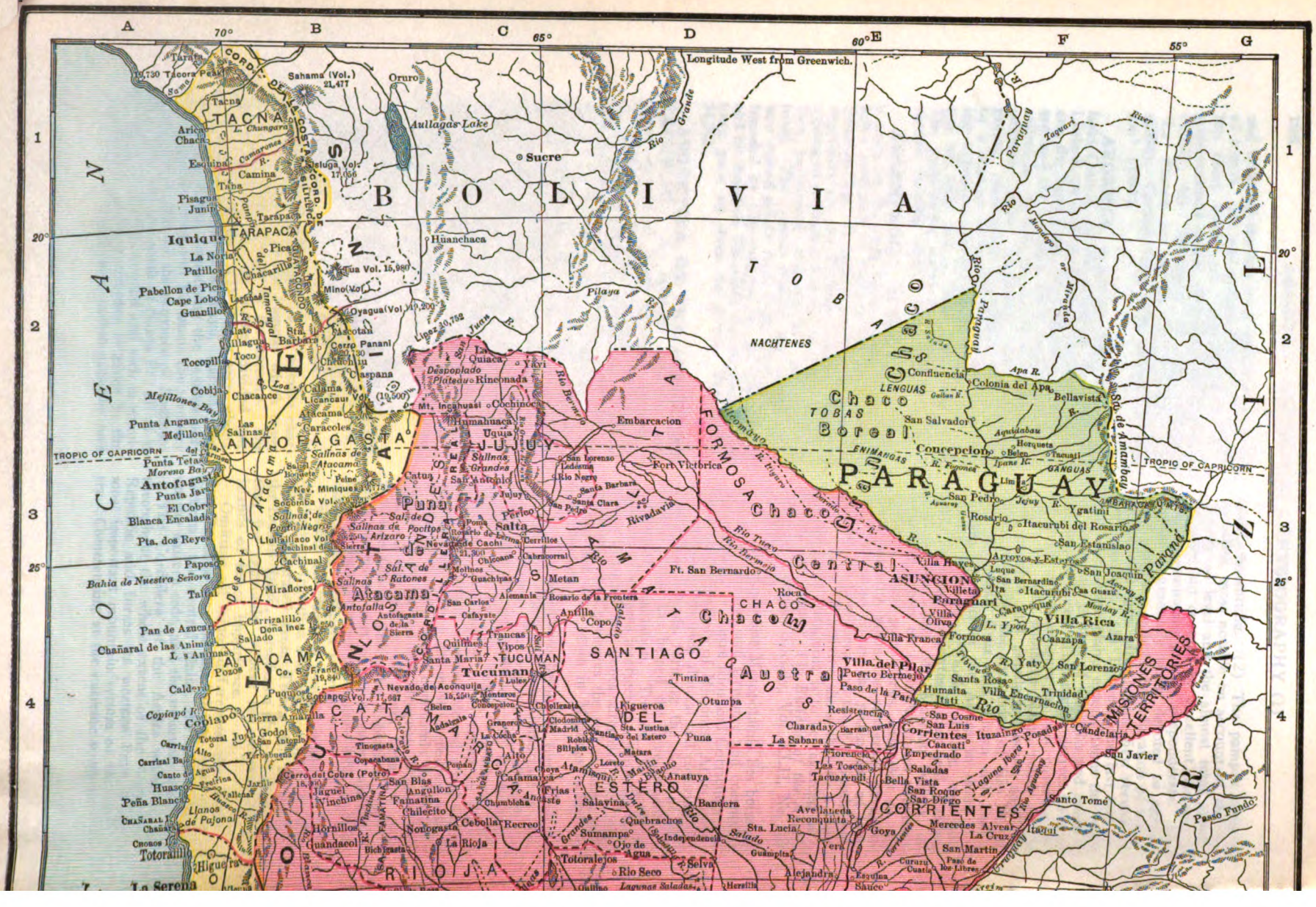
II. The Argentine Mesopotamia lies between the rivers Paraná and Uruguay and comprises the provinces of Entre Rios and Corrientes and the national territory of Misiones. At its southern extremity the rich alluvial soil covering the numberless islands forming the delta of the Paraná River has helped the development of a luxuriant vegetation. Toward the north a network of streams intersect an undulating land where tree-clad hill slopes alternate with rich meadows. At Corrientes the soil is damp and marshy but rises again in Misiones, where it becomes hilly.

III. The mountains belong to four separate systems, of which the most important is the Andean system. The coasts are 1,500 miles in length and are generally low and sandy from Buenos Aires to Rio Negro. South of this point they are higher, often rising in bluffs and cliffs forming innumerable gulfs and bays. In the Plata estuary the most interesting island is Martin Garcia, which commands the mouth of the rivers Paraná and Uruguay. About 400 miles off the shores of Santa Cruz are the Malvinas Islands, which the Argentine government claims as part of its territory although England has occupied them since 1833, having named them Falkland Islands.

Tierra del Fuego is also an island, belonging half to Argentina and half to Chile. Staten Island, separated from Tierra del Fuego by the Lemair Strait, is used as a place of deportation for criminals. There are several other islands of lesser importance.

Omitting all minor differences, the Argentine Republic may be divided into three great sections: the central plains, the river region on the eastern side, and the mountain systems.

The Cordillera of the Andes which runs throughout the whole extent of the Argentine Republic and forms its western limit is the most important mountain system of the country. Commencing at the extreme south of the


Longitude West from Greenwich.
70°
65°
60°E
55°
BOLIVIA
PARAGUAY
CHILE
ARGENTINA
TACNA
TARAPACA
ANTOFAGASTA
ATACAMA
JUJUY
SALTA
TUCUMAN
SANTIAGO DEL ESTERO
CATAMARCA
LA RIOJA
CORRIENTES
MISIONES TERRITORIES
Chaco Boreal
Chaco Central
Chaco Austral
CHACO
FORMOSA
ASUNCION
Villa Rica
Villa del Pilar
Concepcion
Sucre
Oruro
Huanchaca
Aullagas Lake
Pilaya R.
Pilcomayo R.
Paraguay R.
Tagwari River
Apa R.
Confluencia
Colonia del Apa
Bellavista
San Salvador
Horqueta
Belen
Yuquis
Tobas
Lenguas
Ganguas
Embarcacion
Fort Victorica
Rivadavia
Ft. San Bernardo
Villa Hayes
Villeta
Paraguari
Villa Franca
Formosa
Caazapa
Azara
Encarnacion
Itapua
Posadas
Candelaria
San Javier
Santo Tomé
Paso Fundo
Itaqui
Alvear
La Cruz
Mercedes
Goya
Corrientes
Ituzaingo
Caacati
Empedrado
Saladas
Bella Vista
San Roque
San Diego
Resistencia
Charadai
La Sabana
Barranqueras
Florencia
Las Toscas
Tacuarendi
Avellaneda
Reconquista
Sta. Lucia
Guampita
Alejandra
Selva
Rio Seco
Totoralejos
Ojo de Agua
Sumampa
Quebrachos
Salavina
Anatuya
Bandera
Figueroa
Otumpa
Tintina
Loreto
Matara
Frias
Chumbicha
Cebollati
Recreo
La Rioja
Famatina
Chilecito
Angullon
Nonogasta
Hornillos
Guandacol
Bichigasta
Cerro del Cobre (Potro)
Tinogasta
Copacabana
San Blas
Jaguel
Vinchina
Fiambala
Tierra Amarilla
Copiapó
Caldera
Totoral
Carrizal Alto
Carrizal Bajo
Huasco
Peña Blanca
Llanos de Pajonal
Chañaral
Chañaral de las Animas
Pan de Azucar
Carrizalillo
Doña Inez
Sallado
Paposo
Taltal
Miraflores
Punta Tetas
Moreno Bay
Antofagasta
Punta Jara
El Cobre
Blanca Encalada
Pta. dos Reyes
Punta Angamos
Mejillones
Mejillones Bay
Cobija
Tocopilla
Toco
Oxate
Quillagua
Chacance
Las Salinas
Punta Gruesa
Iquique
La Noria
Patillos
Pabellon de Pica
Cape Lobos
Guanillos
Pica
Chacarilla
Lagunas
Camina
Tana
Pisagua
Junin
Arica
Chacha
Esquina
Camarones
Chungara
Tacora Peak
Sahama (Vol.)
Isluga Vol.
Mino (Vol.)
Oyagua (Vol.)
Tua Vol.
Lirpa
Cerro Panani
Chuchulin
Caspana
Calama
Licancaur Vol.
Atacama
Caracoles
Peine
Socompa Vol.
Llullaillaco Vol.
Cachinal
Cachinal de la Sierra
Pocitos
Nevado de Cachi
Chicoana
Molinos
Guachipas
Metan
Alemania
Rosario de la Frontera
Cafayate
Quilmes
Trancas
Vipos
Tucuman
Monteros
Concepcion
Graneros
Lules
Nevado de Aconquija
Famabalasto
Pomahuaca
Uquia
Humahuaca
Cochinoca
Yavi
Quiaca
Rinconada
Mt. Incahuasi
Desposado Plateau
Lipez
Sta. Barbara
Salinas Grandes
Salinas de Arizaro
Salinas de Pocitos
Salinas de Ratones
Salinas de Atacama
Salinas de Pastos Grandes
Salinas de Pocitos
Rio Bermejo
Rio Pilcomayo
Rio Tarija
Rio Tuyuyo
Rio Pilaya
Rio Grande
Rio Salado
Rio Dorado
Rio Paraguay
Rio Montagu
Rio Apa
Rio Aquidabau
Rio Ipane Guazu
Rio Negro
Rio Verde
Rio Monday
Rio Yaty
Rio Aguaray
Rio Jejuy
Rio Yrigoyen
Rio Tarija
Rio Pilcomayo
Rio Paraguay
Rio Parana
Rio Uruguay
Rio Mocoreta
Rio Aguapey
Rio Corrientes
Rio Miriñay
Rio Gualeguay
Laguna Ibera
Laguna Iberá
Laguna Limpia
Laguna Blanca
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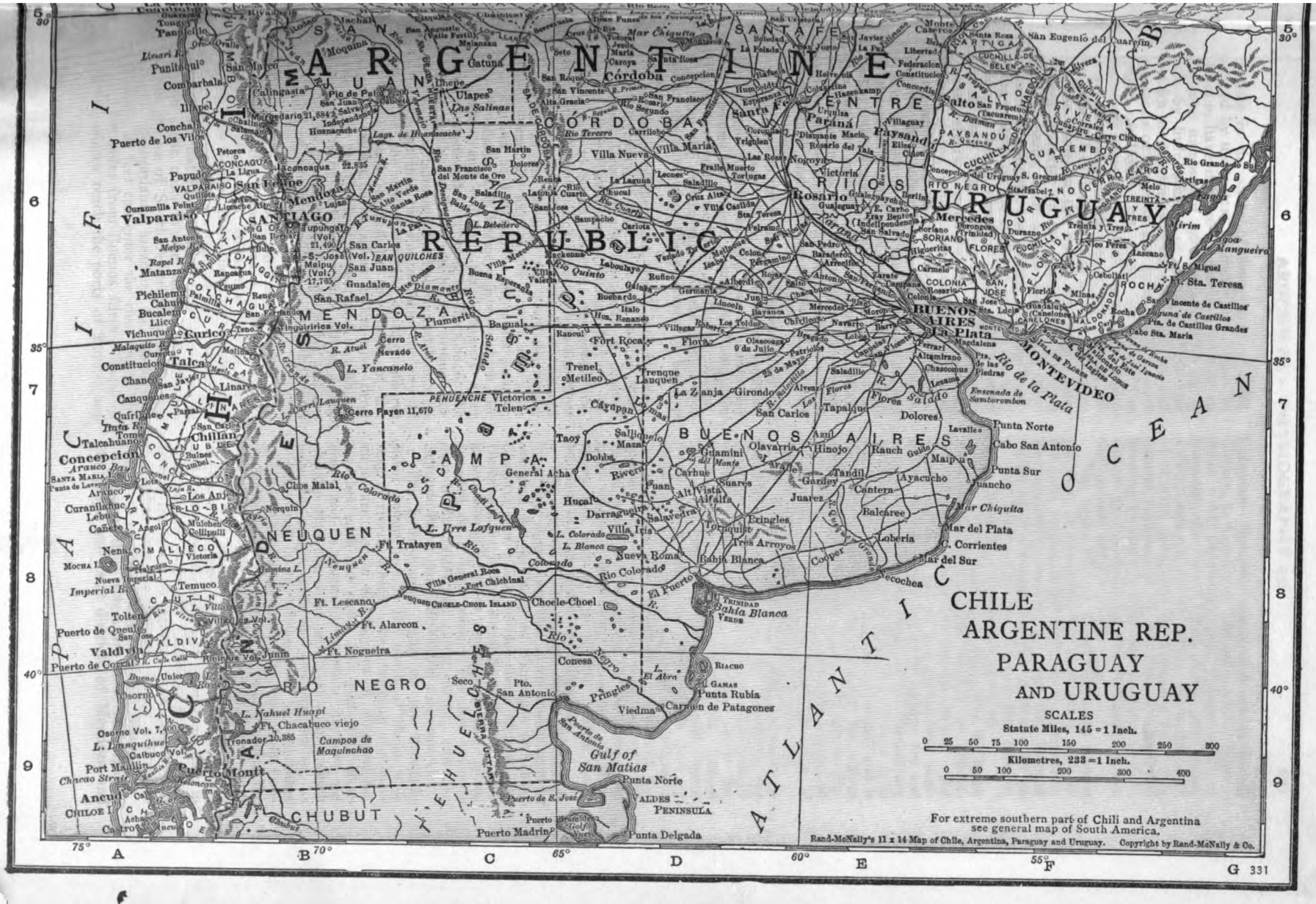
Lagunas Salad


CHILE
ARGENTINE REP.
PARAGUAY
AND URUGUAY
SCALES
Statute Miles, 145 = 1 Inch.
0 25 50 75 100 150 200 250 300
Kilometres, 233 = 1 Inch.
0 50 100 200 300 400
For extreme southern part of Chili and Argentina see general map of South America.
Rand-McNally's 11 x 14 Map of Chile, Argentina, Paraguay and Uruguay. Copyright by Rand-McNally & Co.
ARGENTINE REPUBLIC
CHILE
URUGUAY
PARAGUAY
PACIFIC OCEAN
ATLANTIC OCEAN
Rio de la Plata
Mar Chiquita
Gulf of San Matias
Valparaiso
SANTIAGO
Concepcion
Chillan
Talca
Curico
Puerto Montt
Valdivia
Osorno Vol.
Tronador 10,385
Cerro Payen 11,670
L. Yancanelo
Tupungato (Vol.) 21,490
Aconcagua 22,835
Mercedario 21,884
Las Salinas
Lags. de Huanacache
Rio Tercero
Villa Maria
Villa Nueva
Cordoba
Rosario
Buenos Aires
La Plata
Montevideo
Punta Norte
Cabo San Antonio
Punta Sur
Mar del Plata
C. Corrientes
Mar del Sur
Bahia Blanca
Punta Rubia
Carmen de Patagones
Viedma
Pto. San Antonio
Punta Delgada
Puerto Madryn
Choele-Choel
Ft. Lescano
Ft. Alarcon
Ft. Nogueira
Ft. Tratayen
Villa General Roca
Fort Chilchinal
Neuquen
Rio Negro
Chubut
Mendoza
San Juan
La Rioja
Catamarca
Tucuman
Salta
Jujuy
Santa Fe
Entre Rios
Corrientes
Misiones
Formosa
Chaco
Pampa
Buenos Aires
Rio Colorado
Rio Negro
Rio Chubut
Rio Deseado
Rio Santa Cruz
Rio Gallegos
Cape Horn
Strait of Magellan
Tierra del Fuego
Andes Mts.
Cordillera de los Andes
Sierra de la Ventana
Sierra de Tandil
Sierra de Cordoba
Sierra de Cordillera
Sierra de Pie de Palo
Sierra de Famatina
Sierra de Aconquija
Sierra de Velasco
Sierra de Ancasti
Sierra de Guasayan
Sierra de Ambato
Sierra de Fiambala
Sierra de Copacabana
Sierra de Tucuman
Sierra de Salta
Sierra de Jujuy
Sierra de Santa Barbara
Sierra de Santa Fe
Sierra de Entre Rios
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Sierra de Chaco
Sierra de Pampa
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Sierra de Rio Colorado
Sierra de Rio Negro
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Sierra de Rio Deseado
Sierra de Rio Santa Cruz
Sierra de Rio Gallegos
Sierra de Cape Horn
Sierra de Strait of Magellan
Sierra de Tierra del Fuego
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republic in the shape of low ranges of hills, isolated by the waters of the Pacific which, in addition, have invaded its valleys, forming an immense number of picturesque channels, it little by little became of greater height and breadth until it forms in the north the elevated tablelands of Atacama and Jujuy, with a mean height of 13,000 feet above sea-level. The abundant vegetation which covers its lower slopes in the south disappears on passing beyond the 37° of latitude, and in the same manner the snow, in the north, has only a permanent character on the summits of the most elevated peaks, such as the Aconcagua, Mercedario, Tupungato, and Juenal. Another interesting feature of the southern part of the Cordillera is the existence of deep gullies which run through it and allow the passage of important rivers formed by the waters of the eastern slopes, which otherwise would have found an outlet toward the Atlantic Ocean. Besides the Andean system there is a central system formed by three parallel ranges known by the general name of Córdoba and San Luis ranges; the Buenos Aires system formed by two isolated ranges and the Misiones system formed by the western extremity of two mountain ranges entering the Argentine territory from Brazil and forming a letter Y by their joining together.

In regard to the hydrographic system of the country, we may divide it into four systems: the system formed by the rivers within the Plata basin; the central system, the Patagonian system formed by the basins of the rivers flowing from the eastern slope of the Andes, and lastly, the system of the province of Buenos Aires.

The basin of the Plata, which includes most of the territory of Argentina and part of those of Brazil, Uruguay and Paraguay, is drained by the river Plata, justly considered as the entrance gate to South America; the rivers Uruguay and Paraná which debouch into the Plata after a course of 900 miles in the first case and of 2,000 in the second; the river Paraguay, which forms the axis of the system and joins the Paraná at 1,200 miles from its source; the Pilcomayo and Bermejo rivers which rise in Bolivia and fall into the Paraguay after having crossed the territory of the Chaco; the Salado del Norte River which runs through the provinces of Santiago del Estero and Santa Fé to discharge into the Paraná near the city of Santa Fé; the river Carcarañá, another affluent of the Paraná formed by the union of the Tercero and Cuarto rivers which have their sources in the Córdoba range; and in addition other rivers of less importance, all of which rise in the province of Buenos Aires and are affluents of the river Paraná and the river Plata.

Mr. E. L. Corthell, an American engineer, says that "the Paraná has a larger discharge than the Mississippi; its annual flow is double that of the Ganges, three times that of the Saint Lawrence, four times that of the Danube and five times that of the Nile. There are records of 608 cubic miles in one year." The Paraná River is one of South America's great waterways. Transatlantic steamers of 10,000 tons drawing 23 feet can enter the river up to Rosario, 240 miles from Buenos Aires. Those of 6,000 tons can reach the ports of Paraná and Colastiné. Specially constructed vessels can go farther, to Corrientes, 640 miles above Buenos Aires. At Corrientes the Paraguay River flows into the Paraná which at this point makes a sharp turn toward the south. From the point of view of navigation the Paraguay River is a natural continuance of the Paraná. Steamers drawing 13 feet ply from Buenos Aires or Corrientes to Asunción, on the Paraguay River, during nine months of the year.

The upper Paraná, from Corrientes toward the east, is navigable by large boats only to the falls of Apipé, 145 miles above Corrientes. But smaller steamers ply regularly beyond Apipé up to Posadas and still smaller craft up to near Iguazú Falls, on the boundary line between Argentina, Paraguay and Brazil.

The river Uruguay is navigable by large steamers up to Concordia which is an important agricultural and commercial centre. But during the floods the river is everywhere navigable. These floods are quite sudden but not long continued. The floods of the Paraná are much longer continued, because its source is in the tropical and rainy regions of Brazil and it receives also, through the Paraguay, the waters from the flanks of the Andes. At the confluence of the latter river with the Paraná at Corrientes, the rise of the floods is about 33 feet; at Rosario it is from 19.7 to 23.5 feet.

Of the other rivers belonging naturally to the Plata system, such as the Pilcomayo, the Bermejo and the Salado, none at present is of economic importance. Further south the Paraná River receives the Carcarañá, formed by the confluence of the Tercero and Cuarto rivers which drain the southeastern part of Córdoba. These rivers are used for irrigation purposes and the Argentine government has entered into an extensive program of irrigation works contemplating the reclamation of large tracts of land along the valleys of these rivers and also of the Quinto, which more properly belongs to the central system.

The central hydrographic basin is formed by a vast depression that in its lowest part is occupied by the lakes of Porongos and Mar Chiquita into which several rivers such as the Dulce and the Primero and Segundo fall. Irrigation works in these rivers have been going forward on a large scale. The Rio Primero dam holds 260,000,000 cubic metres and the Segundo River dam 350,000,000 cubic metres.

The hydrographic basin of the Colorado River commences in the north of Rioja with several rivers which, after forming the Bermejo, are lost in the lagunes of Huanacache, together with the rivers San Juan and Mendoza; and in succession to these we have the streams that run from north to south, which join the waters with the Desaguadero or, as we may call it, the channel for the discharge of the lakes of Huanacache, and this conjunction flows on toward the south under the names of Salado, Chadileuvú, and Curico until it falls into the Colorado, having on its course southward formed many lakes and marshes; and lastly the Grande and Barrancas that in combination form the Colorado River, which having traversed the pampas from east to west debouches into the Atlantic Ocean a little to the south of the estuary of Bahía Blanca.

Most of these rivers are used for irrigating the grape and fruit districts of Mendoza and

San Juan, as well as the pasture lands of San Luis.

The basin of the Rio Negro is also of great importance, being formed by the streams which flow down from the Cordillera of the Andes between 37° and 41° south latitude. This basin, like all the others that are found further south, has the peculiarity of encircling within it a large number of lakes which, while constituting one of the principal attractions of the Cordillera of the Andes, have a beneficial influence on the regulation of the waters. There are several other lakes whose natural drainage is the river Limay which, together with the Neuquén, forms the Rio Negro, the mouth of the main river on the Atlantic being a little to the south of the Rio Colorado. The island of Choele-Choel, renowned for its great fertility, is about midway between the confluence of the Limay and Neuquén and the sea, but nearer to the former.

Extensive irrigation works are being completed at Negro River, with the purpose of irrigating the barren pampas stretching between that river and the Colorado, as well as the lands south of the Negro. The Patagonian rivers are also navigable to a certain extent. Flat boats have to be used, however.

The drainage of the remaining lakes of the Cordillera is effected by means of the river Senguer, an affluent of the Chubut; the beautiful lakes of Buenos Aires and San Martín, whose waters make their way through the Cordillera of the Andes to fall into the Pacific in the same manner as do those of the lake Lacar and many others farther north; the Argentino and Viedma lakes whose drainage forms the river Santa Cruz, one of the most important in Patagonia, which, with the Deseado and the Gallegos, completes the hydrographic system of this region.

The most important rivers of the province of Buenos Aires are the Salado del Sur, whose valley is considered as being only a continuation of that of the Rio Quinto, which flows down from the «Sierras» of San Luis. This river gives rise to important lagunes and receives, before falling into the bay of San Borombón, the superfluity of waters of many others.

The remaining rivers of that province which debouch directly into the ocean are the San Borombón, Quequén Grande, Quequén Salado, Napostá, Sauce Grande and Sauce Chico.

As regards the Argentine Mesopotamia, it is, on account of the impermeability of its soil, a region traversed by numerous rivers and streams which flow into the Paraná and Uruguay. The province of Corrientes, in particular, contains the immense lagunes of Iberá and Maloya, up to the present almost unexplored.

To conclude this hydrographic sketch of the republic we may call attention to the existence of a certain number of depressions, occupied by salt lakes and deposits of salt, that constitute so many additional basins into which there flow streams of brackish water, which, on evaporation, deposit the salt they held in solution, forming real natural salt pans, some of them being worked to supply the requirements of the inhabitants of the interior. In the high tablelands of Atacama and Jujuy are other deposits which are doubly interesting on account of the deposits of borax which they contain. There are, also, distributed throughout the whole Andine region, numerous water-courses, which are taken advantage of near their sources for the irrigation of the soil but which, their course being through immense zones of permeable land, are quickly lost in the subsoil. Among these we may mention, as examples, the rivers Tala, the Valle, and the Paclín, which give life to the beautiful valley of Catamarca, and to the city of that name. Irrigation works are also prominent in some of these rivers.

Climate.— Almost any desired climate, from tropical to frigid, may be had in a country that extends through more than 34 degrees of latitude, or more than 2,300 miles, from latitude 22° to 56° south, and is in places 800 miles wide. Conditions vary widely in the same latitude. Rainfall diminishes from the east to the west until the very base of the Andes is reached. Temperature is highest in the central part of the country, falling rapidly in the Andean region to a point many degrees below the temperature of localities due east. Temperature also diminishes toward the south.

In the northern part of Argentina the transition from the rainy to the dry season is very marked. A four-season climate prevails in Corrientes, Entre Rios, Santa Fé, Córdoba, Buenos Aires, Mendoza, San Luis and the remaining country lying south. However, there is always a prevalence of rains from October to April. In the provinces of Corrientes, Salta, Jujuy, Catamarca and Santiago del Estero and the territories of Chaco, Formosa, Andes and Misiones, climatic conditions are those of subtropical countries. In Buenos Aires, Santa Fé, Entre Rios, La Rioja, San Juan and San Luis, south of Corrientes, Santiago and Catamarca and territories of La Pampa Neuquén and Rio Negro, the climate is temperate. In Santa Cruz, Tierra del Fuego and Chubut, the climate is cold but not so severe as to prevent these southeastern regions from being habitable.

The highest recorded temperature, 120°, was during the hot wave of February 1900, in the province of Catamarca at the extreme north, and the lowest recorded temperature was 3°, in the southern extremity of the continent, a range of 117° of temperature in 33 degrees of latitude. The Argentina weather bureau states, however, that lower temperatures are probably experienced in the interior of the territory of Santa Cruz. In the northern part of the Litoral the ordinary range of temperature is from 41° to 106° and in the southern section of the Litoral the usual limits are from 32° to 102°. This is the territory in which most of the corn is raised, and the summer temperature averages from 72° to 77° and is rarely above 96°.

The meteorological system of Argentina consists of 200 meteorological and 1,600 rain-gauge stations. Besides, the Argentine Weather Service receives information from 12 Brazilian, 10 Chilean and six Uruguayan stations. The Argentine weather map issued daily shows conditions reigning from Pará (Brazil) to the southernmost limit of the continent. At the South Orkney station (lat. 61° S.) there is a fully equipped meteorological and magnetic station. The hydrometric service has established nearly 150 river gauges and information is published in the daily weather map as to the depth of the water at the principal ports and shallow passes of the navigable rivers as well

as timely warnings of the approach of the freshets in the rivers. The magnetic service is well equipped for the observation of the solar spots and spectroscopic observations, atmospheric electricity, kite work and the preparation of the isogonic chart of the country.

Geology.— In the Tertiary period the uplifting of the Cordilleras and of the Andes was effected, and the leveling of the Pampas, giving to the country the physical aspect of to-day. The Pampean system is characterized by the abundance of deposits of an argillaceous sand of great fineness, of gray color peculiar to deposits of sand and clay or alumina, the first of which encompasses the slopes of the Sierras, while the second is found along the margin of the Plata. The Pampean system is characterized, moreover, by an abundant and marvelous fauna of fossil mammals.

The works of Florentino Ameghino, who collected hundreds of fossil specimens on the banks of Patagonian rivers, will help in clearing up many points related to the origin and distribution of mammals, man included. The fact that most of the fossils appear in formations older than those in which the same species are to be found in the northern hemisphere is leading some palæontologists to assign man an antiquity not hitherto suspected. In this connection the finding in 1914 by a commission from the Buenos Aires Museum of Natural History of an arrowhead — evidently the work of man — embedded in a bone of Toxodon remains one of the most sensational palæontological discoveries of the age. To comprehend the abundance of fossil mammals in Pampean soil it is necessary to remember that in the Cretacean epoch the southern hemisphere contained relatively more land than water; while in the northern hemisphere the contrary condition existed. This naturally greatly favored the deposit of a varied fauna of mammalia.

The Cretacean epoch is represented in Argentina by the Chubutian and Guaranitican formations, which belong respectively to the lower and upper Cretacean. The former extends over the territory of Chubut, occupying the most central part, and is characterized by a very hard sand of very marked color. Both land and marine fossils are found in it. The latter formation is found in Corrientes and Misiones, reappearing in the Rio Negro and also in Chubut, resting upon the former.

The period of the Tertiary epoch is represented along the coast of Patagonia and seashore region from Puerto Madryn to the bottom of the Gulf of Nuevo, as far as the mouth of the Santa Cruz River, where it disappears under the Atlantic. The fossils are marine on the coast, and land toward the west. To the south of Patagonia, between the rivers Chico and Gallegos, there extend other formations of the same period.

The Oligocene period is represented by a succession of layers principally of marine origin, which appear in the province of Entre Rios along the whole length of the Paraná River. The same layers reappear farther south at the mouth of the river Negro and extend along the Patagonian coast as far as the Gulf of Nuevo.

Remains of the Miocene period cover the central and southwestern Pampas, as well as a portion of Catamarca and Tucumán. To this period belongs the immense quantity of rounded gravel which covers the whole surface of Patagonia from the river Negro to the south.

Of the Pliocene period may be found representations in the Pampean formation, or in the great deposit of lime and reddish gray clay which covers the province of Buenos Aires.

Representations of the Quaternary and recent epochs are met with in isolated deposits throughout the length of the republic.

Flora.— According to Professors Holmberg, Spegazzini, and Gallardo, the Argentine flora represents almost one-tenth of the flora of the world. Professor Stuckert claims to have studied and classified as many as 8,000 phanerogamous and vascular cryptogamous plants. The number of known plants among the cryptogamous alone is calculated at 3,000 species. Only a fourth of the phanerogamous and less than a tenth of the cryptogamous plants have been classified. The microscopic flora is almost entirely unknown. The province of Buenos Aires is almost devoid of trees; the only part where they are found is along the coast, but they are small and consist principally of mimosæ, which make excellent fuel. Calden is to be found in the west. In part of Santa Fé, the Chaco, Santiago del Estero, Entre Rios, Corrientes, Misiones, Tacumán, etc., there are immense forests of the finest and most useful classes of trees, from the easily worked cedar to the quebraco (axe breaker) used for railway sleepers, ñandubay for fencing posts, lapacho, algarroba and numerous varieties of wood for shipbuilding and furniture. The ombú is useless as timber, and is not even suitable for firewood, but is valued for its shade, while the ceibo bears an extremely beautiful flower of a deep crimson color.

Fauna.— Very few species of animals pertain exclusively to Argentina. Among the mammals are recognized two, the vizcachá, which is not found outside of the Pampas, and the hare of Patagonia. Among birds may be numbered two species characteristic of Argentina; the marineta, a bird of the heron family, and the gallito, or small cock, which also live on the Pampas, but farther south than the two species first named. Most of the animal species which live in Argentina are met beyond the frontiers of the country in Brazil, in Bolivia and in Chile. Some of these are also common to the Antilles and to North America.

There is a great variety and diversity in the fauna, according to the region studied, since the animals of the east or of the north differ considerably from those of the west and the south. Dr. Lahille has divided southern South America into three regions: (1) The Andean, which comprises the whole of Chile, all of Patagonia and the greater part of the Andean provinces; (2) the central region, formed by the basin of the Paraná River; (3) the Brazilian, which comprises the territories of Misiones, a part of the province of Corrientes, and also the northern part of the republic of Uruguay. In the eastern zone of Argentina live the animals that have emigrated from the tablelands of Brazil.

The wild animals are numerous, being the jaguar (tigar), puma (leon) and various kinds of wild cats, the aguara-guazu (fox of Paraguay), an animal of a reddish color with a

black stripe along the back; gray and red foxes, various kinds of weasels, otters, skunks or polecats, nutria, a rodent which is called an otter but is Myopatamis Copyus, having a tail like a rat; seals, opossums, raccoons, vicuña, huanaco, elamas and alpacas, the last two said to be the domesticated varieties of the preceding two, various kinds of deer varying in size from that of the red deer of Europe down to 18 inches in height; armadillos of four varieties, the wild guinea pig, the pampa hare, which is not a hare but Dolichotis Patagonica, and several monkeys, carpincho or water hog, vizcacha or prairie dog, tapir, peccari, ant-eaters. The vizcacha was some years ago very numerous, but is not now to be found on the inside camps, that is land that has been stocked for many years, as a war of extermination was waged against them some 25 or 30 years back. Birds are also numerous, the more notable being the vultures, hawks, ostrich (rhea or fiandu), eagles, owls, parrots, woodpeckers, ovenbuilders, humming birds, ibis, flamingo, spoonbill, swallows, pigeons, doves, egrets, storks, wood turkeys, partridges of various kinds, snipe, plovers, ducks, swan, geese, gulls, bustard and in the far south the penguin and other sea birds. The house sparrow was introduced some years ago and has now become a thorough nuisance, as are also the descendants of imported hares in Santa Fé and the north of Buenos Aires.

The best fish are the pejerrey (a kind of trout), dorado (something like salmon but of a golden color), corvina, palometa, pacú, anchoa (a large fish not a bit like an anchovy), flatfish, zurubi, an immense yellow and black spotted catfish. The only fish we know that will take the artificial fly are the pejerrey, dorado and the mojarra, a small fish very like a sardine. Alligators are still to be found in the upper Paraná and Paraguay; iguanas are to be found in the northern provinces and lizards throughout the country.

Snakes are numerous but the only dangerous ones are the rattlesnake and the vibora de la cruz; possibly some of the large water boas may be so, but no instance has been reported of man being attacked by them.

Some years ago it was successfully demonstrated that oysters could be brought from the favored localities of the United States and placed in the bays of the Atlantic coast of this republic and there multiply, grow and fatten.

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2. POLITICAL DIVISIONS, POPULATION AND IMMIGRATION. The Argentine Republic consists of 14 provinces, 10 territories and a federal district. These, with their areas and populations, are as follows:

PROVINCES	Area (in square miles)	Population
Buenos Aires (Federal District)	72	1,594,170
Buenos Aires	117,777	2,155,118
Santa Fé	50,713	922,406
Córdoba	66,912	598,545
Entre Ríos	29,241	423,100
Corrientes	33,535	365,434
San Luis	29,035	126,895
Santiago del Fuego	55,385	247,004
Tucumán	10,422	348,582
Mendoza	56,502	296,553
San Juan	37,865	130,412
La Rioja	37,839	104,550
Catamarca	36,800	112,995
Salta	48,302	161,150
Jujuy	14,802	73,062
TERRITORIES		
Misiones	11,511	52,603
Formosa	41,402	27,902
Chaco	52,741	49,500
Pampa Central	56,320	98,841
Neuquén	40,530	30,085
Rio Negro	79,805	37,302
Chubut	93,427	25,143
Santa Cruz	109,142	8,630
Tierra del Fuego	8,299	2,420
Los Andes	34,740	2,552
Total	1,153,119	7,979,259

The returns of the 1914 census, published in September 1916, gave 7,885,237 inhabitants as the total population on 1 June 1914. The 'Argentine Year Book,' 1915–16, gives, as the estimated population for 1915 (a calculation by the National Statistical Office), 7,979,259. The estimates 9,000,000 or 10,000,000 frequently given appear to be based upon the growth of cities, with which the rural population does not keep pace. The urban population, constituting 42.8 per cent of the total population of Argentina in 1895, increases from year to year out of all proportion to the rural; and the movement toward the cities, especially Buenos Aires, has been marked in the decade 1908–17.

Of the total population of the republic about 2,000,000 are foreigners, or more than 25 per cent as against 10 per cent in the rest of South America and 13 per cent in the United States. About one-fifth of the entire population of the country is in the capital city, of which about 40 per cent are foreigners. This shows that an undue proportion of immigrants remains in Buenos Aires, while the sparsely settled country districts have received a minority of them. To counteract this tendency the Immigration Bureau now offers free lodging during 10 days in the agricultural centres to all those immigrants willing to go there. Transportation to those districts is also free to the immigrant, his family and baggage.

Only second and third class passengers are considered immigrants by Argentine law. Immigration regulations are very strict regarding health of immigrants and the hygienic and safe conditions of steamers carrying them. On their arrival at Buenos Aires immigrants are provided with board and lodging, valid for five

days, which term may be renewed in case of sickness. The Immigrants' Hotel is a model establishment offering accommodations for 1,000 persons at a time. Dormitory buildings, dining hall, lecture-rooms, lavatories and hot and cold baths and swimming pools are the chief features. There are also immigrants' hotels at Rosario and Bahía Blanca. The National Labor Bureaus use every means to find a situation for the immigrant in the art, craft or industry in which he wishes to apply himself. Since the country was opened to immigrants in 1854 about 4,750,000 immigrants have entered Argentina, of which number 30 per cent have returned to their native land. In 1913, the year before the European War, 302,047 immigrants entered Argentina. The immigrants have come in great numbers from Italy and Spain, and lately from Russia and the Balkans. The immigrants can acquire rich government land without being subjected to nationalization. Provision is also made for the supply of the necessary funds to furnish the colonist with implements and other equipment to enable him to begin work immediately.

One of the drawbacks the country has had to contend with is that the feudal land system instituted by Spain was continued under the republic. The conquered land in the provinces was already mostly held in private estates. The remnant was won by degrees from the Indians. After conquering from them the rich lands of southern Argentina in 1885, land was sold off in blocks with a square league (6,250 acres) as a unit at a nominal price. The army received a vast grant of these lands in payment of the work accomplished. All these tended to create vast latifundia which, fortunately, are being gradually broken up. From 1905 to 1915 the number of holdings of less than 12,000 acres has increased in the proportion of 100 to 171, while the number of big holdings of 12,000 acres upward has diminished in the proportion of 100 to 56.

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3. HISTORY. Exploration Period.— Spain, not being satisfied with the discoveries and conquests which she had effected in America, was made ambitious by her rival, Portugal, regarding the known riches of the Molucca Islands, in the Malay Archipelago. To possess herself of these she looked for a channel between the Atlantic and Pacific oceans traversing the new continent, and the mission of finding this was entrusted to the most able mariner of the day, Capt. Juan de Solis, who in 1515 A.D., navigating with two boats along the coast of America, arrived at 35° S. latitude. He proceeded along what is now known as the river Plata (Rio de la Plata) until he reached the mouth of the Uruguay River, and anchored his vessels there, in front of a little island which he named Martin Garcia, in honor of the second commander of the expedition.

Solis and some of his companions went to the eastern bank of the river, but they had hardly disembarked when they were killed by the Charrua Indians. Deprived of their leader the company did not venture to begin the exploration of the newly-discovered country, and returned to Spain. This dismal failure disheartened the Spanish government until 15 years later, when the discovery of Brazil and the conquests of the Portuguese revived the ambition of Spain. In 1526 the Spanish government sent nearly simultaneously two expeditions to the south, one under the command of Diego Garcia, with the intention of stopping the advance of the Portuguese, and the other in charge of the English captain Sebastian Cabot, with the object of finding an interoceanic passage. The lack of provisions and a mutiny among the sailors prevented Cabot from carrying out his designs, and unfortunately while navigating in the river discovered by Solis, and following the Uruguay River, the detachment that disembarked to explore the region had no better fate than that of Solis and perished at the hands of the Charruas. Cabot therefore changed his route and discovered the mouth of the Paraná. Here he established in the delta the first European port in the region of the Rio de la Plata, the fort Espíritu Santo. Ascending the Paraná to its junction with the Paraguay, Cabot began trading with various tribes of Indians, whom he found using many silver ornaments and utensils. This excited the cupidity of the explorer, who, thinking he had discovered a region of silver mines, named the estuary then known as Rio de Solis the Rio de la Plata, or Silver River.

By chance the expedition of Diego Garcia, which, as previously stated, had been sent out to stop the advance of the Portuguese, arrived at the mouth of the river Plata. Quarrels broke out between the two commanders which obliged Diego Garcia to return to Spain, and fearing the decision of the government at Madrid would be unfavorable to himself, Cabot returned to Europe, leaving large supplies in the fort Espíritu Santo, which was soon assaulted in an unexpected way and burned to the ground by the Timbu Indians, who up to this time had maintained friendly relations with the Spaniards.

These early discoveries in the Rio de la Plata led to a great deal of jealousy and desire for territorial expansion on the part of European monarchs. Carlos V, King of Spain and Emperor of Austria, who was at war with Francis I of France, not being able to disband his army nor to give much attention to the conquest of America, decided to send out explor-

ing parties to annex definitely the territory of the river Plata. A rich Spanish noble, Don Pedro de Mendoza, arranged with his government to equip at his own cost an expedition, on condition that he was to be named governor over all the territories which he discovered or conquered. The Mendoza expedition consisted of a fleet of 14 vessels and about 2,000 men, many of whom were Germans. This force entered the river Plata 20 Feb. 1535, and landed on the spot where now stands the capital of the Argentine Republic. There a town site was chosen, Mendoza giving it the name of Santa Maria de Buenos Aires, which means Saint Mary of the Good Breezes. Subsequently the little town was destroyed by the Querandi Indians who inhabited the region. The expedition escaped to the Espíritu Santo fort, leaving seven horses and five mares, the first herd of horses in Argentina. From Espíritu Santo Mendoza sent his principal lieutenant, Don Juan de Ayolas, to explore the Paraná River. After numerous fights with the various Indian tribes Ayolas occupied the land and founded the town of Asunción in 1537. He intended later to penetrate as far as Lima in Peru. Mendoza, sick and discouraged, started to return to Spain, but died on the way. Ayolas succeeded him in command of the Spaniards on the Plata.

From Asunción, Ayolas went on an expedition to Peru, and upon his return was killed by the Indians. This expedition brought from Peru some ewes which had been imported from Spain via Panama. These ewes constituted the nucleus of the Argentine flocks. Several years before this seven cows and one bull, the first cattle in the river Plata territory, had arrived at Asunción.

All the people who did not care to follow Ayolas on his unfortunate expedition across the unknown continent remained in Asunción. Among them were many Germans and some French, Belgians, and Italians. They elected Domingo Martinez de Irala as governor, and formed the first autonomic government of South America, organizing the first colony and entering into friendly relations with the neighboring tribes of Indians.

The polygamous condition of these tribes made easy the multiplication of the colonials, thus originating the half-breed type, who in their turn joining with the Europeans gave the racial character of the new population of the region. D'Orbigny thus describes the Mestizo, or mixed blend of people: "The mixture of the Spaniards with the Guaranies produces men of large form, nearly white, and having beautiful faces even from the first generation; large eyes, clear complexion, and nose generally like the Spaniards. As a rule they have scanty beards until the third generation, when it becomes as thick as the white man's."

During the second half of the 16th century, while they were founding and organizing the governments of Paraguay and Rio de la Plata, other expeditions leaving Peru by land explored and settled the interior territory of the Plata. In this way were founded the cities of Estero, Tucumán, Córdoba, Salta, Rioja and Jujuy. Other conquerors, coming from the general headquarters in Chile, took possession of the Cuyo region and founded the cities of San Juan, Mendoza and San Luis.

The inefficiency of the military conquest of the Indians and their continued insubordination decided the government at Asunción to try to bring them into submission through the medium of church missions, which they commissioned the Jesuit Fathers, already established in Peru, to undertake. The missionaries founded their schools in Salta, Córdoba, and Santa Fé. Others went to unexplored sections and established missions with the most perfect theocratic government among the Guaranies.

The government of Spain, after the death of Irala, sent out Don Juan de Garay as governor of Paraguay. Needing a fortified position nearer to the ocean, Garay descended from Asunción resolved to reconquer the site occupied by Mendoza in 1536, and succeeded in re-establishing, 11 June 1580, the abandoned colony of Buenos Aires. Plans were made for the laying out of the town which the Indians again tried to destroy. The first inhabitants of Buenos Aires were 19 Spanish and 50 Creoles. With the founding of Buenos Aires the period of conquest in the region now comprising the Argentine Republic may be said to have finally closed, to be followed by the colonial régime.

The desire to secure communication between Buenos Aires and Asunción necessitated the foundation of various forts and colonies along the Paraná River in the region which to-day constitutes the provinces of Santa Fé, Entre Rios, and Corrientes.

During this time the Portuguese were advancing their explorations south along the Atlantic coast, arriving at the left margin of the Rio de la Plata. This alarmed the Spanish government, which, being powerless to quell the internal anarchy of the colonies while in the midst of the fight with rebellious tribes of Indians, separated Buenos Aires from the government of Paraguay, instituting the province of Rio de la Plata dependent on the viceroy of Peru, and named for governor-general Bruno de Zabala, who, in 1726, founded the city of Montevideo, now the capital of the republic of Uruguay.

The Spanish government did not permit commercial importation through the port of Buenos Aires and the colonists of this region were obliged to resort to troublesome transcontinental traffic to reach Lima, the capital of the viceroyalty, the only market of importation which they could count on. But as Paraguay received direct importations in freight boats for the official agents of the Spanish government, and the traffic necessarily had to pass near to Buenos Aires, the inhabitants of this city devised methods to organize a trade with Cadiz, from which place there were secretly sent to Buenos Aires books that the Spanish government did not permit to circulate even in Spain, which contained comments on the American Revolution and philosophical writings such as preceded the French Revolution. One can understand that these books found eager readers, since the cultured class of Buenos Aires had been recruited from liberals, who, fleeing from persecution in Spain, preferred as a refuge the modest city on the banks of the Rio de la Plata to the brilliant capital of Peru, centre of military and ecclesiastical prestige and head of an aristocracy formed from descendants of successful adventurers. The liberal ideas of this class separated them somewhat from the theocratic and military influence

which ruled the interior, but during the next two centuries Buenos Aires received only such liberal literature as could be smuggled from Europe.

Colonial Period.— In the middle of the 18th century Spain was engaged in war with Portugal, which, allied with England, sent a fleet to the Rio de la Plata and took possession of a small port on the left bank of Buenos Aires. The government sent forces which repelled the invasion and, in view of the fact that the river la Plata required more safeguards, reorganized the colonial administration, constituting the viceroyalty of Buenos Aires with its jurisdiction in the territories now occupied by the republics of Uruguay, Paraguay, Bolivia and Argentina, and opening in 1776 the ports of the river Plata to importation.

The first viceroy, Zeballos, explored part of the coast of Patagonia. His successor, Juan José de Vertiz, a Mexican of excellent antecedents, dedicated himself to the advancement of the city of Buenos Aires, using for this object the property confiscated from the Jesuits by Carlos III. Buenos Aires at that time, 1778, contained 22,000 white inhabitants, of whom 15,000 were European Spaniards. The total population of the country was 300,000, of whom 10 per cent were negroes or mulattoes. The buildings were almost exclusively of unbaked bricks, roofed with straw. The increase of the horses, abandoned by Mendoza, that had scattered themselves through the pampas, had modified the traits of the Indians of the region, who, becoming horsemen, fled from the harsh treatment of their conquerors.

The facility with which a colonist could make himself a large landed proprietor, and the impossibility of inducing the natives to work, promoted the importation of negroes as slaves, and in 1715 the government had conceded to an English company the monopoly of importing 1,200 negroes a year, which concession, however, was abolished in 1728, although the importation continued in a very light proportion till the beginning of the 19th century.

At this time it was the custom of the wealthy class in these colonies to send their studious young men to complete their education in the schools and colleges of Europe. The unliberal spirit which ruled in the University of Córdoba in the centre of the country did not attract the young men of Buenos Aires.

In 1806 an English expedition, returning from the conquest of the Boer colonies at Cape Town, South Africa, crossed the Atlantic and invaded Buenos Aires. The viceroy, Sobremonte, fled to the interior of the country, leaving the defense of the city to the Spanish residents and natives. The English assault was repelled, all being made prisoners, although taking advantage of the confusion, the invaders seized $1,500,000, which was in the fiscal treasury and which they sent to England. This produced an extraordinary effect in London in regard to the riches of the Rio de la Plata region and induced the English government to send another and better equipped expedition, consisting of 60 boats and 12,000 men, to take possession of Buenos Aires. This second attempt, however, had no better success than the first and many English prisoners remained in the country where they eventually intermarried with the natives. The authorities and the Spanish residents accused the masses of sympathy with the invaders; nevertheless the English were freed and received by the first families, thus helping to constitute the liberal element which was later to have the direction of the revolution of independence.

The Republic.— The government of Spain, alarmed at the projects of Napoleon, could not extricate itself from warring elements and had refused to send aid for the defense of the river Plata. The citizens of Buenos Aires, proud of their triumphs and dissatisfied with the viceroy, Sobremonte, deposed him and named as his successor Liniers, a French captain who had helped them in the first defense against the English; but the Spanish government denounced this act and appointed as viceroy a Spanish marshal, Cisneros. At this time, because of Napoleon's domination over Spain, the authority of the Spanish viceroy was not recognized and fresh germs of independence were sown. With this impetus some of the patriots met and announced a government Junta. This assembly took place 25 May 1810, the date which the Argentine Republic celebrates as its birthday. This congress invited all the authorities of the viceroyalty to join the movement, and founded a periodical of revolutionary tendencies called *The Buenos Aires Gazette;* for it was evident that the power of Spain could only be broken by united effort of the patriots who were scattered throughout the southern portion of the continent, and that Buenos Aires was the natural leader in such an enterprise. The colonial authorities, however, refused the invitation and, supported by the loyal colonists, repelled the revolutionary expeditions which were later sent from Buenos Aires to overthrow the Spanish authorities.

For seven years the success of the insurrection remained in doubt. The Argentines suffered defeats in Paraguay and in Upper Peru (now Bolivia), and the Spanish held unconquered the fort of Montevideo at the mouth of the river Plata. During this time the enthusiastic propaganda for liberty and equality, and the revolutionary documents sent out from Buenos Aires to all the colonies, had awakened fanciful ambitions and uneasy repinings among the natives and illiterate semi-barbarous half-breeds, who during the progress of seven generations — more than two centuries — had submissively considered themselves inferior to the whites. So when the Argentines had once conquered the Spanish forts of Montevideo and Asunción, the provinces of Paraguay and Uruguay declared themselves independent.

By 1815 the leaders having sown anarchy in all the colonies, the revolutionary government of Buenos Aires saw itself beset by the danger of invasion of the territory of the provinces of the Plata by the forces under the command of the Viceroy of Peru, and on the borders of the Plata River by the Spanish fleet. In such emergencies the larger part of the directors of the revolutionary movement felt powerless to follow the model of the republic established by the English colonies in North America and discussed a monarchical government (one of the leaders even proposed annexation to the British empire) in order to link the provinces of Rio de la Plata with

European countries, and to silence the resentments of Spain. At the same time they would submit to the insurgents who were breaking up the country by encouraging the passions of the half-breeds, and stimulating their narrow clannishness which they disguised under the name of federalism. To bring about a crisis the revolutionary government convoked a congress of representatives from all the provinces united with Buenos Aires. This congress met in the city of Tucumán 9 July 1816, and pledged itself to a Declaration of Independence for the United Provinces of Rio de la Plata, a date which the Argentines celebrate as a national holiday. The Congress of Tucumán, where the local element predominated, decided also that the form of the government should be democratic-republican-federal, by which title the Congress exalted the elements of anarchy and diminished the prestige of the active industrial class which produced the independent movement whose centre was Buenos Aires.

England and the United States, the former to limit the political power of Spain, the latter to remove from the American continent the other great powers, were the first nations to recognize the independence of the Argentines. It was then that President Monroe proclaimed the doctrine, "America for the Americans." However, the Spanish rule was not ended in America, but maintained itself firmly in the rest of the colonies. It was the destiny of Argentina to fulfil her mission as Liberator.

Lima, the capital of Peru, was the centre of the Spanish power which extended through the latter country, Chile, and the northern part of South America, Central America, and Mexico. Besides, the Spaniards still held the city of Montevideo, which was their bulwark on the Atlantic coast.

To reach Lima by land was a task beyond the bounds of possibility, on account of the geographical conditions which favored the Spanish troops by offering them a safe position within easy reach of their headquarters. The Argentine Congress had the good fortune, however, to find a soldier of genius to whom they confided this new undertaking. His name was San Martín. Realizing the risk of meeting the Spanish forces on land, he conceived the project of crossing the Andes to drive out the Spaniards from Chile and to reach Lima by sea. This bold enterprise was secretly preparing for two years, and in 1817 General San Martín led across the Andes an army of 5,000 Argentine soldiers, largely recruited from the hardy plainsmen and cowboys. This little force of rough-riders, by defeating the Spanish troops in the battle of Chacabuco, gave independence to the Chilean people. San Martín was also successful against the Spaniards in Peru, entering Lima as a liberator in 1821. Though urged to take the civil government of the countries he had freed, this soldier of splendid quality refused the rewards, honors and offices of civil life, which men fulfilling similar missions in other countries have almost without exception consented to receive.

While the patriotic army gloriously ended their campaign on the Pacific, ambitious leaders had converted the country at home into various feudal dependencies, which were at war with one another. The government, being powerless to contend with the factions, dissolved, leaving the provinces to take care of themselves. This picture of savagery discouraged San Martín, who, upon his return from his campaign, despairing of seeing the return of order and peace in the new communities, retired to France, where he died some years later.

The province of Buenos Aires had, no doubt, an exemplary government. The soul of it was Bernardino Rivadavia, a mulatto, who, as secretary of the government, completed commercial treaties with England and other countries, and obtained in London, through the Baring Bank, a loan of £1,000,000 at 6 per cent interest, which was totally covered at the fixed rate of 70 per cent. He also interested some small English capitalists in the enterprise of sending over the first herds of fine cattle.

Rivadavia also founded a bank of discount and for the issue of paper money, which began its operations with an issue of $290,000, the first Argentine currency.

But the half-civilized conditions continued in the rest of the country, though the leaders of emancipation tried to reunite the provinces under national control, naming Rivadavia as President. Here we encounter the origin of the two great political parties in the history of the Argentine Republic, one being the Unitary, which favored a strong central government, in opposition to the localism of the Federals, or State-Rights party.

Rivadavia advanced his epoch, and to him Argentina owes many progressive ideas, among others the governmental ownership of the land and the natural sources of wealth. He carried on great works of public utility, employing the funds obtained from Baring Bank to found schools, universities, a national bank, hospitals and other benevolent institutions. However, he could not triumph over the local rivalries and, discouraged, like San Martín, gave up the government, which dissolved immediately, having been unable to crush out anarchy, which now broke out more furiously than ever. The discount bank of the province of Buenos Aires had been changed to a national bank, and its issue of paper money now rose to $2,700,000, yet the payment of the debt to Baring Bank had not even been commenced.

The new Empire of Brazil, heir to the Portuguese policy in South America, expected to reach the river Plata and to dominate Montevideo, the capital of the republic of Uruguay. Buenos Aires, which had inherited at the same time the Spanish secular views, notwithstanding that it was itself menaced by anarchy, aided the Republic of Uruguay to obtain its independence from Brazil in a war which lasted three years and whose chief purpose was to drive out the Brazilians from the Plata (1828).

The anarchical wars had reduced considerably the masculine part of the population, which in 1810 numbered half a million, the fourth part of which were quadroons descended from half-breeds, mulattoes, and negroes. A leader unbalanced and fierce, Juan Manuel de Rozas, chief of the federals, now assumed command, and pleased himself with collecting the savage negroes of the population, some 40,000, recently emancipated slaves, nearly all in the province of Buenos Aires, and

bringing about the exile of the cultivated and industrious elements, who took refuge mostly in the republic of Uruguay and in Chile. The reckless spirit that during 25 years reigned in all the local military dictatorships had ended in destroying the mining and wine-making industries that the Spanish colonies had started in the interior.

The diplomats of Europe, acknowledging the Monroe Doctrine, hastened to recognize the self-styled republic. In 1829 England recognized the independence of the new country and entered into diplomatic relations with the tyrant Rozas. The final recognition of it by Spain in 1842 completed the assurance of the leaders, who, confident of their independence, had now no other idea but to destroy each other.

Of all the old provinces of the ancient viceroyalty of Buenos Aires, the only one which prospered through these years was the new republic of Paraguay, in reality an absolute kingdom at the mercy of the powerful will of the tyrant dictator Francia. Its independence was recognized by Europe and Brazil but not by Buenos Aires, and this made it impossible for Paraguay to enlarge its outside commerce, as its only outlet to the sea was by way of sailing 850 miles on the rivers Paraná and Plata. This obliged them to pass in front of Buenos Aires with all their export and import traffic.

Because Rozas at Buenos Aires could close the natural channels and hinder the traffic of Paraguay with Brazil and Europe, the English and French governments decided in 1845 to establish a blockade of Buenos Aires and open to free navigation the Paraná, and thus assure international communication with Paraguay. This blockade lasted two years, and in 1847 the English fleet abandoned the waters of the Plata. During these two years the English officials tried to excite the settlers of Buenos Aires to rise against the tyrant Rozas, but they were weak and timid and did not think they could free themselves without the help of the exiled patriots and their allies. Various attempts had been made to expel Rozas but without success until, understanding that the problem was not local but national, they united with the expatriated from other provinces, and counting on the help of the dictator who ruled the province of Entre Rios (separated from Buenos Aires by the Paraná River) and with the aid of the troops sent by the Empire of Brazil, they deposed Rozas and instituted the national government with its capital in the city of Paraná, province of Entre Rios. Then, taught by experience, the people resolved to safeguard their rights and privileges for the future. On 25 May 1853, a Constitution closely resembling that of the United States was formed, with some modifications, particularly in regard to civil legislation which is national and not provincial, and the United Provinces of Rio de la Plata took the name of Argentine Republic (from the Latin *Argentum*, silver).

Constitutional Consolidation.— Here began a period of national reconstruction and the normalization of the provincial autonomies. The country entered into commercial treaties with various European countries and with Brazil, and began to pay the Baring Bank of London the accumulated interest and collateral on the loan obtained by Rivadavia 25 years before. The national bank, founded by Rivadavia and converted into a mint by Rozas, became the Provincial Bank of Buenos Aires.

The ensuing years witnessed some practical advances, such as the inter-provincial telegraph, the construction of the first railroad, and communications by steamboat between the Rio de la Plata and Europe, reducing to 40 or 50 days the passage which up to this time had taken three or four months by sailing vessels.

But the incipient economic interests had not yet much political representation. Personal rivalries among the commanders of the army, and the troublesome pride of Buenos Aires, jealous at seeing the national capital in the city of Paraná, separated that province from the rest of the confederacy, and civil war began once more, hindering the steps of real progress which had been taken. After various bloody battles, in 1861, the hegemony of Buenos Aires threatened the integrity of the rest of the country and the provisional capital was moved to that city. But the aggressions of the tyrant Solano Lopez, dictator of Paraguay, a country which had been formed under the fiercest of the dictatorships which the people of the south had been subjected to, had forced Brazil to war. The invasions into the Argentine territory by Paraguayan armies, which moved toward the republic of Uruguay with a view to assuring an outlet to the ocean, provoked the offensive and defensive alliance of Brazil with the republics of Uruguay and Argentina, which brought on a devastating war that lasted five years, and in which 70,000 combatants took part. Its outcome was the complete overthrow of Paraguay, whose male population was reduced to one-tenth.

Already the Argentine government had become suspicious of the policy of Chile, a country less democratic than its neighbors, who found themselves exhausted by civil and other wars. Chile manifested a strong inclination to obtain ports on the Atlantic side of Patagonia. Notwithstanding the complete victory over Paraguay, the Argentine government asserted the doctrine that "victory does not give rights," and offered to submit to the arbitration of President Hayes of the United States the question of the boundaries of Paraguay, thus making an honorable precedent in international policy.

The costs of the war with Paraguay were defrayed by a loan contracted with the Bank of London. The honorable arrangement which in 1854 the government had proposed to the Baring Bank to pay the debt made in 1825 had aroused English capitalists, who not only covered the loan for the war but also organized railroad and marine transportation companies.

The continuous issue of fiat money had depreciated the currency to an extreme limit so that the rate of exchange was 27 pesos to one gold dollar. In 1867 the Provincial Bank established the rate of exchange at the fixed point of one dollar gold for 25 paper, and vice-versa.

The war, notwithstanding its epidemics and miseries, did not wholly check the progress of civilization. The struggle with the foreigner united the confederate provinces against Buenos Aires, which, though politically allied

to the rest of the country, socially still felt itself aloof. At the same time the influx of British capital and the entrance of some thousands of immigrants changed this feeling a little. Meanwhile citizens who were enthusiastic admirers of the republic of the United States endeavored to make this the general opinion, and in 1868 a pacific presidential election took place in Argentina, resulting in the choice of Domingo Sarmiento, who was at that time the Argentine Minister in Washington. He was devoted to the progress of civilization in South America, through schools and industries. He established throughout the country compulsory and free public schools, and inviting normal teachers and scientists from the United States and Germany, he founded institutions of scientific and general culture and strengthened the sway of the national Lyceums, instituted by his predecessor, General Mitre, and established in all the provinces. Sarmiento obtained from the Bank of London $5,200,000 gold, which he employed in public works.

Faith in the progress of the country had grown much firmer through the fact of the peaceful presidential election. People trusted in personal and property guarantees, and the rural industries, using wire fences to enclose pastures, passed from the nomadic and route systems which the cowboy had opened up to civilization. But the adventurous element of the low class, result of the mixed races, and composed of uncultured men, asserted their rights to political equality, stirred up provincial revolutions and uprisings in the city of Buenos Aires, placing again in constant uncertainty industry and commerce and checking immigration. Yet through it all the new modes of communication and the work of Sarmiento little by little made stable the growth of civilization.

As a result of wars and revolutions the scourge of cholera for two years decimated the country and an epidemic of yellow fever, brought from Brazil, in its turn for a third time destroyed the population on the banks of the Plata, whose death rate remained for years about 45 per thousand. In 1873 the population of the city of Buenos Aires was about 220,000, almost all whites; the whole population of the country was about 2,000,000, nearly a third part of them half-breeds. Stability of money was impossible, and the Provincial Bank closed its office of exchange. The wars of independence, revolutions and uprisings during the period of anarchy and tyranny, the war with Paraguay and the civil wars had reduced considerably the masculine part among the creoles half-breeds, and negroes, so that the feminine element made alliances with the European immigrants.

But the foreigner, who was indifferent to the quarrels of the political leaders and to the depreciation of paper money, which had fallen to the ratio of 30 to 1, entered heartily into agriculture which had recently shown unusual results, and the political leaders became uncertain of a field for their propaganda, warlike and personal.

Withal they had to solve the problem of the capital, up to that date provisionally located in the city of Buenos Aires, which was also the capital of the province of the same name. In 1880, because of the presidential election, the national government, which was beginning to organize its small army in the conquest of the desert, reducing the nomadic tribes which existed in those regions, and which had extended the railroads to the distant provinces, and increased the schools, was violently expelled by the government of the province of Buenos Aires, which, with the help of the party preponderant in the city of Buenos Aires, headed by ex-President Mitre, resisted the entrance of the national forces. After many bloody combats, however, the national forces triumphed and fixed forever the national capital at Buenos Aires.

The government of Buenos Aires province removed its capital in 1882, founding the city of La Plata on the banks of the river of that name, 57 kilometres from the city of Buenos Aires. The founding of this city of La Plata cost $30,000,000.

After the Paraguay War the two political parties ceased to exist. This gave rise to the founding of personalistic parties named for their leaders. After having lost the city of Buenos Aires in 1880 the party of Mitre retreated from the electoral struggle, and their chief, General Mitre, devoted himself to literature and high politics, becoming a famous figure in the nation, and popular with the masses, on account of his daily paper *La Nacion*, which united the characteristics of the English daily and French review. The electoral withdrawal of the Mitristas gave opportunity to the party of Federal origin, which was under the control of General Boca, who was then President of the republic, to take possession of all government positions, both national and provincial.

Chile, having defeated Peru and taken from it the provinces of Tacna and Arica, now raised the question of the boundaries along the ridge of the Andes. Being short of squadrons and provisions to defend the desert coast of Patagonia and the valleys of the Andes, the Argentine government ceded a part and recognized the claim of Chile to part of Patagonia and Tierra del Fuego; and by common agreement both governments left out the surveying of the boundaries of the land, thus allaying fears of a new war.

Although in the hands of the party of Federal origin and under a Federal Constitution, the national government adopted as its own the program of centralization laid down by Rivadavia, the founder of the Unitary party, and continued somewhat the work of progress begun by Sarmiento. It secured another loan from the Baring Bank for $12,000,000 gold, at the rate of 90 per cent and at 1 per cent interest, to be used in railroad extension. Two years later, in 1882, it obtained another loan of $9,000,000, gold, at the rate of 84 per cent and 5 per cent interest, to found a national bank, and immediately Parliament authorized another loan of $20,000,000, gold, for public schools.

The conquest of the desert and the reduction of the Indian tribes was followed by great prosperity, enriching the government by the possession of millions of square miles of excellent ground for pasture. These most valuable regions were divided among the military who had made the campaign of the desert, and government politicians. The increase of immi-

gration, which was now about 100,000 a year, in most part northern Spaniards and northern Italians, attracted by the advertisements of free lands and the advantages offered by the government, and the investments of foreign capital in railroad companies and public improvements in the cities of La Plata and Buenos Aires, inflated considerably the price of land in the hands of the military and government leaders. In less than one year it doubled in price. The national government continued to ask for loans from the Bank of London, and again obtained $20,000,000, gold, at 6 per cent interest, for the construction of the port at Buenos Aires. In 1886 another loan was made of $42,000,000, gold, at 80 per cent rate and at 5 per cent interest, to unify diverse loans for public works.

In these conditions the military, in great part made up of half-breeds and quadroons, enriched by the gain of their desert conquests, and by the prodigality with which the London bankers loaned money to the government, outshone the old, cultured and quiet well-to-do people of Buenos Aires and other centres. The latter were descendants of the patriots of the War of Independence, and of the exiled patricians, yet they were overshadowed by the new military plutocracy, who had no thought but ostentation, and were destitute of all idea of duty, civic and social. They simply centred in Buenos Aires to enjoy life in pseudo-Parisian style.

In 1886 the government, hindered by the difficulty of obtaining more loans in London, abolished the law of "conversion," and began again to issue millions of fiat money, thus giving a chance to stock jobbing and producing an extreme instability of currency, which in 1889 had a relation of five pesos to one gold dollar. At that time the fiat money reached the sum of $80,200,000. The London bankers had not only been beguiled into loaning money to the national government, but had also made loans to provincial and municipal governments to the extent of $80,000,000 in gold, which was largely embezzled by the intermediaries in Europe and the retainers of the authorities of those centres.

Recent History.— In the Pan-American Congress held at Washington in 1889, the Argentine representatives, fearing the interpretation Mr. Blaine gave to the Monroe Doctrine, "America for the Americans," would be ratified by the Congress, declared as the Argentine sentiment, "America for Humanity," expressing the Argentine inheritance of blood and of interests through the mixtures of the Spanish, English, French and Italian races, and its independence of the rest of the American continent outside of its own boundaries.

Argentina now had more than $500,000,000 English capital invested in the country and more than a half a million Italian citizens. Political and administrative corruption, however, seemed to know no bounds. Fiat money reached $197,000,000, making the national dollar less than 30 cents, gold, and the credit of the country was compromised in loans of more than $300,000,000, gold, covered by mortgages on its inalienable property and interests, which amounted to more than 40 per cent of its estimated wealth.

The inaction of public opinion and the lack of any party of opposition moved the young men of the universities and those in active business to form a protesting party — "The National Civic Union," — which in a few months after its founding conspired with some of the chiefs and officials of the army and navy, and incited mutinies and mobs which drove the President, in 1890, to resign his position. The Vice-President, Dr. Pellegrini, a man of great energy and capacity, but lacking political tact, remained in office and partly quelled the provincial revolutions. Meanwhile, the personalist leaders, reviving the traditions of the old parties, Federal and Unitary, separated the elements which formed the young party of the Civic Union.

The national government had to ask delay from the European banks, and finally the National Bank with the Provincial Bank of Buenos Aires failed. The Argentine credit was completely lost, immigration ceased as well as the coming in of foreign capital; public service became uncertain. Money was wanted to prosecute public improvements and education. The country found itself exhausted, and again threatened by Chile, which had recently come out of a cruel civil war, the only one in its history, and had been cleverly militarized under the direction of German officials. Now Chile wanted the boundaries on the Andean frontier to be made at once. As the interests of English and Italians were great in Argentina the danger of war opened again an opportunity for credit to improve the national defense, and the government spent more than $100,000,000, gold, in forming a modern navy, making strategic lines and military posts, and purchasing military supplies. During this time agriculture and stock-raising prospered and in a few years doubled the exportation.

The government in 1891 founded the Bank of the Nation and offered to the public a subscription for $250,000,000, to be used as its capital. The public did not respond to any extent and the government only saved the situation by resorting again to the issue of fiat money. In 1892 the government founded the "Caja de Conversion" (Exchange office) and in 1899 modified its organization, forming a reserve fund to change the bills in circulation at the price fixed by law of 44 cents, gold, to one peso, and pledging itself to set aside gold corresponding to this price for each new issue. See BANKING AND FINANCE.

Disquietude over the boundaries of Chile and the costs occasioned by it did not disappear till 1902, when the differences were referred to and settled by the King of England, followed by a treaty of partial disarmament, signed in Buenos Aires, in 1904, the only instance of the kind in the history of peace, and which reflected great honor on both peoples.

The hard experience during a decade of complicity between some national and local leaders and European bankers which endangered and discredited the country, and another decade of anxieties and expenses for the national defense, moved Argentine opinion to sustain the Calvo doctrine, proposed by Drago and upheld by the Argentine representative, in the Pan-American Congress at Rio de Janeiro, 1906, according to which the new nations have a right to repudiate the debts contracted with foreign banks which enter into treaties and plots with the reckless heads of government.

This was opposed to the Roosevelt doctrine according to which payments of debts contracted by the agents of those in authority are to be coerced from the defrauded people.

The rare coincidence of the almost simultaneous disappearance of men who were most prominent in politics — ex-President Gen. Bartolomé Mitre, ex-President Dr. Carlos Pelligrini, President Dr. Manuel Quinta, ex-Gov. Dr. Barnardo Trigoyen — whose deaths occurred in 1906, left the party of opposition without leaders, and the old political Unitary organization changed its name, substituting for it "The National Autonomistic Party," directed by ex-President Julio A. Roca.

In 1906 Dr. Figueroa Alcorta was elected President. Serious disturbances occurred during the first week of May 1909, in consequence of labor troubles and anarchist agitation. On 13 March 1910 Dr. Roque Sáenz Peña was the successful candidate for the presidency. Two months later Buenos Aires was thrown into great confusion by an attempt to call out a general strike. The 100th anniversary of the birth of the nation was celebrated 25 May. Diplomatic relations between Argentina and Bolivia, which had been interrupted as a result of boundary disputes, were resumed in January 1911, through the good offices of the United States. In November 1913 Colonel Roosevelt, ex-President of the United States, visited the Argentine Republic. On 9 Feb. 1914 the ministry resigned, after President Sáenz Peña, who had been ill for a long time, turned over his functions to the Vice-President, Dr. Victorino de la Plaza. On 25 April, four days after the United States had inaugurated hostilities at Vera Cruz, diplomatic representatives at Washington, D. C., of the "A. B. C." powers, Argentina, Brazil, and Chile, offered to act as mediators between the American and Mexican governments. (See MEXICO — HISTORY). In 1915 the first actual treaty between Argentina, Brazil, and Chile, signed at Buenos Aires 25 May, provided for five years of peace between the three nations, during which time each of said nations was pledged not to make war on either of the others until the causes of conflict should have been investigated and reported upon by an impartial commission. Independence Day was celebrated with special ceremonies — that being the centenary — on 9 July 1916. Argentina, after more than 80 years of distracted political life hindering its development, has succeeded in the last 25 years in establishing its prominence among the young nations, and in bringing to itself immigrants from the European races. On 12 June 1916 Hipolito Irigoyen was elected to the Presidency. His administration was at once confronted with a national problem, which arose from the sinking of Argentine vessels by Germany. On 16 April 1917 a mob attacked the German Legation and Consulate and the offices of German journals in Buenos Aires in retaliation for the ruthless destruction of Argentine shipping and commerce. A protest was made by Germany which was answered in a conciliatory tone by Argentina, who at the same time sought guarantees for the safety of her merchant shipping in the war zone. Many times in the course of the following months diplomatic relations were strained to the breaking point, but a crisis was reached in September 1917, when the Department of State of the United States made public dispatches from Count Luxburg, German Minister at Buenos Aires, to his government, in which he advised "sinking without leaving a trace" of Argentine vessels. The Argentine people, now thoroughly aroused, demanded the prompt severing of relations with Germany and late in September the lower house by a substantial majority and the Senate almost unanimously (23 to 1) voted to sever diplomatic relations with Germany. Meanwhile Germany recalled Luxburg and he was given his passports. For subsequent developments see LATIN AMERICA AND THE WAR.

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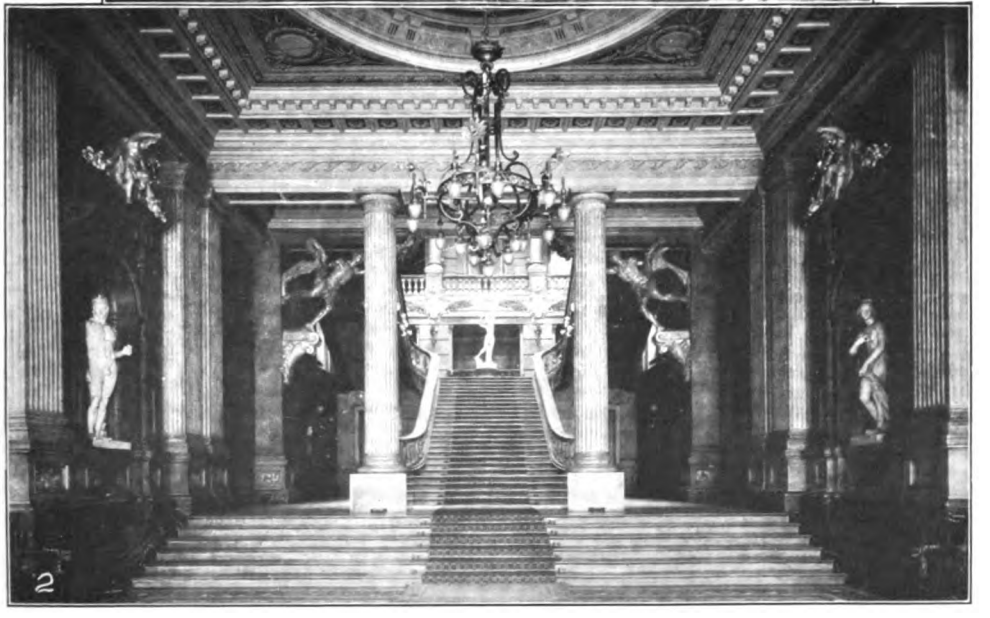
JUAN A. SEÑILLOSA,
Former Argentine Consul-General to Canada.

4. GOVERNMENT. The form of government of Argentina is a representative republican-federal one, modeled after that of the United States of North America, and in accordance with its historical antecedents every province keeps its own peculiar autonomy, drawing up its own constitution, fixing the number of its magistrates, the organization of its municipalities, and administering its property without the intervention of the national government.

The executive power is vested in an officer bearing the title of President of the Nation. The terms of office of the President and Vice-President are six years, and they cannot be re-elected until after the passing of a presidential period. The Ministers are eight: Interior, Foreign Relations and Worship, Treasury, Justice and Public Instruction, War, Navy, Public Works, and Agriculture, Industry and Commerce.

The legislative power is vested in two bodies or chambers, that of the deputies and that of the senators. The former are elected by a majority of the votes of the people, and the latter by the legislatures of the provinces, thus ensuring two senators for each Federal State and two senators for the capital elected by the people.

The judiciary is vested in the Supreme Court of Justice, Federal Chambers of Appeal in the capital and also in the cities Córdoba, Paraná and La Plata; Federal courts in the capital and throughout the provinces and territories; Chambers of Appeal in the capital for civil, commercial, criminal and correctional cases. Each province has its own judicial system with a Supreme Court and several minor courts. Penal, civil, commercial and military laws are national laws, uniform throughout the republic and codified under national codes. The provinces can only enact such laws of procedure as do not affect the national laws.



1 Jockey Club Building, Buenos Aires

2 Grand Staircase, Jockey Club Building

ARGENTINA

1 Board of Education and School Museum, Buenos Aires
2 Argentine Pavilion, Museum of National Products, Buenos Aires

The seat of the national government is Buenos Aires, the Federal capital of the Republic. The national territories are ruled by governors appointed by the Executive Power, with the consent of the Senate.

The governors of the provinces are elected by the people. Foreign citizens can hold real estate.

Article 14 of the Constitution provides for the absolute freedom of the people of the nation in the exercise of their religious faith.

There is no state religion though in accordance with the Constitution the state contributes to the support of the Roman Catholic religion, the expenses of which are about $1,000,000 in gold per year; but it likewise contributes aid for the support of educational or charitable institutions established by other denominations. In 1884 civil marriage was established.

The ecclesiastical government consists of an archdiocese and seven dioceses, under the patronage of the national government which authorizes or prohibits the carrying out of papal decrees.

ERNESTO NELSON,
Director-General of Secondary, Commercial and Industrial Education of the Argentine Republic.

5. **EDUCATION.** As reformed in March 1916, this comprises six divisions: Primary (four years), Intermediate (two years), Secondary (five years), Normal (four and seven years), and Higher education (from five to seven years). The sixth division includes Industrial, Commercial and Education of the Abnormals and is called Special Education. Agricultural education is partly controlled by the universities and partly by the Department of Agriculture. Public education is free throughout.

Primary.— Primary schools are the concern of state (provincial) authorities. The exceptions are: the control of the primary schools of the Federal city of Buenos Aires by the National Board of Education, and a system of subsidies by the Federal government for the benefit of certain provinces whose finances are not equal to the needs of primary education. In 1894 there were 3,000 primary schools, public and private, which increased during the next 20 years to 7,877 schools; likewise did the teaching force of these schools grow from 7,800 to over 26,000 teachers, 80 per cent of whom are women. The pupils attending the primary schools in 1894 numbered 280,000, whereas in 1914 the attendance increased to 900,000 pupils. The expenditures incurred for the maintenance of the schools rose sixfold. Population increased less than twofold during that period.

Secondary.— Secondary education was originally shaped after European models, but the schools are already responding to the modern demands of democracy. From mere preparatory institutions for the university they are fast becoming schools of advanced education to an increasing number of men and women. In 1894 the students in secondary colleges numbered 3,000, which number rose to 10,000 in 1914, the expenses being increased from $400,000 to $2,500,000. There are 33 of such lyceums (16 in 1894) eight of which are in the city of Buenos Aires (only one in 1894). Secondary education is not compulsory.

Normal.— Normal schools are for primary teachers and for secondary teachers. There are also special institutions for teachers of modern languages and of physical training. Normal schools for primary teachers numbered 70 in 1914 (10 of which were in the city of Buenos Aires) with an enrolment of 8,970 students, about six times those enrolled 20 years before. They offer a four-year general course followed by a three-year special course leading to the professor's diploma. Teachers graduating from normal schools are eligible for positions of $900 a year. Principals get from $1,250 to $1,500. After 25 years teachers may retire with 95 per cent of their salary, provided it has been earned during four years and also that the candidate is more than 45 years old. Normal schools for secondary teachers offer courses in different specialties besides the general courses. Graduates who secure positions as teachers in secondary schools get from $800 to $3,600. Salaries of principals vary from $2,500 to $4,000 a year. Both teachers and principals also retire with the 95 per cent of their last salary, but only after 30 years' work the remaining conditions being equal.

Minor terms of special study are required for qualification for the professions of chemist, midwife, dental surgeon, surveyor and architect.

The University of Córdoba is composed of the school of medicine, the school of engineering and the school of law, in connection with the National Academy of Sciences.

In order to follow his profession in the country, the professional graduate of a foreign university is obliged to prove his ability by means of an examination before some Argentine university.

Technical.— Technical education also is encouraged by the national and provincial governments. Prominent among those of the first category are the national industrial schools, similar in type to the manual training high schools in the United States, although the courses cover six years and afford specialization in engineering, architecture, chemistry and mechanics. Other technical schools of a vocational type provide training in the various trades. There are about 15 trade schools for girls also under the control of the national government giving instruction in dressmaking, embroidery, millinery, flower, lace and glove making, metal work, telegraph operating, drawing, painting and industrial arts. Several provinces also have established schools similar to these.

Agricultural.— Agricultural education is of a two-fold type, special and general. Special or so-called regional schools look toward the education of future workers in special fields, such as the sugar industries of Tucumán, the wine industries of Mendoza, the lumber industry of Misiones, the dairy industry of the Plata Valley, the fruit industry of San Juan and several other regional activities. Other schools provide for the thorough scientific instruction underlying all agricultural occupations, and they are of a type similar to the agricultural colleges in the United States.

Commercial Schools.— Commercial schools for men and women offer courses in commercial practice (five years), bookkeeping (four years) leading to the degree of public accountant (three more years). A more recent addition to the scope of the commercial schools is the degree of doctor for advanced work in economics.

Other Educational Interests.— Besides

national schools for abnormal children, deaf, dumb and blind, the government is establishing a number of special schools for weak children in need of fresh air as well as mountain or seaside climate. In connection with such provisions for the health of children it is interesting to mention here that every school child in the city of Buenos Aires is given a glass of milk at the noon hour. After 15 years of such practice milk drinking has become a habit among all classes of the population, thereby reducing the consumption of intoxicating liquors.

The National Academy of Fine Arts gives free instruction in drawing, painting, decorative and industrial arts.

Popular interest in education is shown by the number of organizations established either with the purpose of studying educational problems, helping the schools or conducting educational centres. The working classes themselves, through the Socialistic party, have done considerable good in organizing lectures, educational excursions and other elements of self-improvement.

Education of women has made great progress in Argentina. In certain districts primary and secondary schools are co-educational. Also some of the normal schools and all the universities. Pedagogical departments are well patronized by women who also are pre-eminent in medical studies. Women take an active interest in social work, notably through the remarkable Philanthropic Association, which although recognized and endowed by the national government is practically under the management of a woman's board. Women are active in education and have also done much to bring the child-saving agencies to the present state of efficiency.

The national government, as well as some of the provinces, maintains numerous scholarships to support Argentine students in England, the United States, Canada, Italy, France and Germany. Those in the United States number about 50, and as many more are supported by their own means or enjoy private scholarships; they are principally engaged in studying engineering, agriculture and commerce.

No fewer than 300 young Argentinos are attending courses in Europe, the great majority of them paying their own expenses.

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6. AGRICULTURE. Under this title we shall endeavor to treat of Argentine agriculture as the great importance of the subject deserves, in the broadest sense of the word, with such economic, geographic and even historic implications as are, for the sincerity and thoroughness of our study, really indispensable.

The area of land under cultivation is more than 95,000 square miles, and its chief products are as follows: Wheat, more than 105,000,000 bushels; oats, 61,000,000 bushels; maize, 190,000,000 bushels; linseed, 40,000,000 bushels; sugar, more than 280,000 tons. Analyzing the statistics for recent years we find that between 16,000,000 and 17,000,000 acres are devoted to wheat, about 16,000,000 acres to alfalfa, 10,000,000 to 11,000,000 acres to Indian corn (maize), over 4,000,000 acres to linseed, and over 3,000,000 acres to oats, the other crops being barley, sugar cane, grapes, rice, potatoes, cotton, tobacco, etc. But the fact is to be noted that of the somewhat more than 1,000,000 square miles embraced in the republic more than one-third (about 334,000) are arable. In other words, 241,000 square miles of the arable regions remain to be brought under cultivation. It is therefore proper to regard the present output of cereals, despite its unquestionable importance, as only a promise of the vastly greater crops which will be secured when the limit of Argentina's potential productivity has been even approximately attained. Moreover the agricultural system accepted and practised in Argentina at the present time is as far as possible removed from the intensive system, its aim being simply and frankly, and perhaps with overemphasis of facility, to obtain the maximum of profit with a minimum of capital and labor. Compare it with the agricultural system of Canada. We may call the former "extensive," the latter intensive. Thus, in Canada the farms of less than 200 acres constitute 88 per cent of the total of holdings of rural property; in Argentina the holdings are relatively large and it appears that farms which best respond to the present conditions of agriculture there are those of 500 to 750 acres. The capital required for farming operations in Canada is $59.25 gold per hectare (2.47 acres) including the value of the land, buildings and machinery; in Argentina, $27.70 gold per hectare. The amount produced in a given area by the Argentine farmer can be greatly increased whenever it becomes more profitable to cultivate intensely than simply to extend the margin of cultivation.

In addition to the arable regions we have to consider a second one-third part of the entire area of the republic — roughly speaking 333,000 to 335,000 square miles that can be utilized for sheep or cattle and to a large extent already have been assigned to the stock-raising industry. In fact live-stock has been, from the early years of Spanish colonization, one of the two principal sources from which the wealth of the inhabitants has been derived; and the figures given in a recent census are, for the entire country: 80,000,000 sheep, 29,500,000 bovine cattle, 9,700,000 horses, 452,000 goats, 3,050,000 pigs and 920,000 asses and mules — the estimated total value being $700,000,000 gold. The nucleus of the supply of live-stock was derived mainly from Peru and Spain in the 16th and 17th centuries.

The remaining areas are commonly assumed to be (in the agricultural sense) unproductive; and as an illustration or the most striking example of the worthless section, it has been customary in the past to mention Argentine Patagonia. But in the light of recent investigations and practical experiments we are enabled to correct that erroneous impression; and it is reasonable to expect that the whole subject of Argentine agricultural expansion will be revised when essential new facts, which would have been called heresies even a decade or so ago, are arrayed against very old but wholly unwarranted prejudice. Our task at the moment is to set forth such essential facts.

Agricultural Patagonia.— Argentine Patagonia is divided into five parts, namely, the territories of Rio Negro, Neuquén, Chubut, Santa Cruz and Tierra del Fuego, whose combined areas (about 775,000 square kilometres or

THE HARBOR OF RIO

MAY AVENUE, BUENOS AIRES

The Government House is in the distance

302,250 square miles) exceed the total area of Chile, and constitute between one-third and one-fourth of the entire area of the republic of Argentina, or nearly one-twentieth of the continent of South America. A comparatively small portion of the Patagonian regions belongs to Chile, and forms the Chilean territory of Magallanes. In view of the circumstance that its climate, ranging from temperate to cold (since it extends, roughly speaking, between lat. 40° S. and lat. 55° S.), favors the development of vigorous communities, we note with special interest records of Patagonia's agricultural achievements which demonstrate the fertility of the soil, accessibility of the interior districts, facilities for irrigation, etc. The question whether this distinctly habitable one-twentieth of South America possesses such elements of substantial prosperity has entered a new phase; and it is obviously a very large question. The 18th century witnessed a race between England and Spain for the control of this region. In 1774 the Jesuit, Thomas Faulkner, having penetrated to the heart of the country, found the interior so unexpectedly desirable that he urged England to undertake its conquest. The Spanish government, when this project became known, hastened to take formal possession of the coast by establishing forts there. On 15 Dec. 1778, an expedition was sent from Montevideo, and, after a voyage of 22 days, a landing was made on the north shore of Valdez Peninsula. The bay (a portion of the Gulf of San Matias) where this landing was effected received the name of San José. Spanish settlements were established there and at Puerto Deseado — the latter in what is to-day the territory of Santa Cruz. When Spain was on the point of losing forever her control over Argentina, England decided to strike, but aiming first at the capital, neglected to put sufficient force into the blow — and the captured English regimental flags are still to be seen in frames and under glass on the pillars of San Domingo Church at Buenos Aires. A quarter of a century passed. Argentina, distressed by war and political dissensions, was shunned by nearly all Europeans excepting soldiers of fortune. Then, after 1832, the world received from one of its greatest men extremely unfavorable impressions in regard to this portion of the far south. When Captain Fitzroy on the *Beagle* was devoting his attention to Patagonian hydrography, Charles Darwin, as the naturalist accompanying the expedition, pursued his investigations on land. But inasmuch as Darwin's studies were in the main confined to the dreary repellent wastes of the littoral, he of course depicted the land in darkest colors on account of its lack of vegetation. To this condemnatory judgment was due, in part, the delay in colonizing central and southern Patagonia. Genuine colonization of central Patagonia — the Chubut territory — began in the year 1865. In 1862 an important emigration society had been formed in England with the object of establishing colonies in Patagonia. Two representatives had examined Chubut Valley and subsequently applied to the Argentine Minister of the Interior, Dr. Rawson, for an assignment of national government lands. In the name of the government the minister stated that he was ready to give to each family of immigrants an adequate portion of the national land. On 28 July 1865, a ship arrived from Liverpool with 153 Welshmen on board, and in September of the same year Colonel Murga, thereto commissioned by the government, came to point out to the immigrants the land assigned to them in Chubut Valley. On 16 September the colony was formally established. The Argentine flag was hoisted and the place received the name of the Minister of the Interior, Rawson. From the very beginning a lack of means of subsistence occasioned great suffering. Forty-eight newcomers abandoned the community, and the government, whose energies were absorbed by the war with Paraguay, could extend no aid. Fortunately the starving Welshmen obtained a little food from the Tehuelche Indians. The second harvest was a failure because the rainfall was insufficient. When the colonists abandoned their settlement and betook themselves to the neighborhood of the port of Madryn, Dr. Rawson promised support to the poor people and requested them to remain one year longer in the colony. Thereupon irrigation canals were cut. At one stroke the situation changed. Splendid crops of wheat were produced. From the year 1867 onward the harvests were good, but communication with the outside world was very imperfect. Application was made to the national government for assistance in exporting wheat. New bands of Welsh immigrants came in 1874 and 1875. Chubut wheat was then sent to Buenos Aires and the Falkland Islands. The colonists established a species of autonomous government, electing for this purpose a council which consisted of 12 members and which promoted the public interests and discouraged private quarrels. This council of 12 elected a president. Thus matters stood until 1876, when a commissioner was appointed to represent the national administration. In 1881 the inhabitants of Chubut Valley numbered 1,000. The law of 16 Oct. 1884 relating to the national territory prescribed for Chubut the following boundaries: On the north, lat. 42° S., on the east, the Atlantic Ocean, on the south, lat. 46° S., and the Chilean frontier on the west. Under this law a governor, a Federal judge and other officials were assigned to each territory. The first governor of Chubut, L. J. Fontana, installed the territorial administration at Rawson. Governor Fontana promptly realized that he knew nothing about the 10,000 square leagues constituting his realm. Therefore, in the spring of the year 1885 he set out with 30 men to explore the Andean valleys. The entire outfit — provisions, a large number of cattle, etc. — had been supplied by the participants themselves; and the reason why so many colonists undertook the journey was that certain friendly Indians had told them about the fruitfulness and beauty of the Cordillera valleys, and the agreeable climate prevailing there had been the subject of much praise. The interior of Chubut had, indeed, been studied at certain points by foreign geologists and botanists but not a word had been said about the agricultural possibilities of the hinterland; and in Buenos Aires the commercial world knew probably less about the southern territories than did the people of Europe.

Fontana's expedition reached the foot of

the Cordilleras after a journey of three months, and there the wanderers discovered a beautiful wide valley which their leader, in honor of the day on which the territorial divisions had been decreed, named Valle 16 de Octubre. A stock-farming colony was founded there. Fontana has characterized the newly discovered regions in the south as follows: "There were 30 of us and we belonged to four different nationalities, yet all declared to me unanimously that they had seen no other spot on earth where nature had combined on such a liberal scale whatever is necessary for the welfare of mankind."

A word of explanation is necessary in regard to conflicting accounts of certain portions of the Patagonian territories. The Rio Negro Valley and Limay region have been described by some writers as very fertile, while other writers have represented them to be entirely worthless for agriculture. If a visitor happened to come at the close of a rainy season he found luxuriant vegetation; whereas another visitor arriving in time of drought could scarcely obtain fodder for his horse. The facts that the wheat grown in the valley of the Rio Negro is as good as or better than the Chubut wheat, and that both are superior to the wheat grown in the warm northern provinces, desèrve to be kept in mind.

Increase of Agricultural Resources.— The assertion has been made that the Rio Negro Valley in many respects is like the Nile Valley. Its total length, from the point where the Neuquén and Limay rivers unite to form the Rio Negro to the disemboguement of the latter in the Atlantic, is about 275 miles, and the average width about four miles. Great Britain's old ambition to which we have referred has in our own times manifested itself in the construction of railways and the investment of very large sums of money in the development of the country. On 1 June 1899 the railway connecting Bahía Blanca and Buenos Aires with Neuquén was opened, and this gave ready access to regions which formerly were reached by long stage-coach journeys. The English spirit of daring which undertook the extension of the great system of the Southern Railroad merits recognition. The region to be crossed was in part so poor that the prospect of good financial returns was frankly admitted to be remote, and no colonization could be expected to follow except in the Rio Negro Valley. But English capitalists looked far beyond the present and saw in the line connecting Bahía Blanca with Neuquén only the first half of the great Trans-Andean route, which should supply, for the products of south Argentina and south Chile, an outlet at that point (Bahía Blanca) which has, as its most valuable asset, a natural harbor, much deeper and better for large vessels than the harbor of any other place in the extreme southeast. As evidence of the interest that the Argentine government takes in the southern territories, we may mention the construction of the Patagonian Railroad, which was begun in 1908. The discovery of petroleum about 1907 near Comodoro Rivadavia is another factor in the growing prosperity of southern or Patagonian Argentina. It is to be noted also that the cultivation of cereals, with all its promise, is not the most important source of wealth. Stock-farming, especially sheep-farming, dominates here; in fact, this region sustains a relation to the provinces on the Rio de la Plata analogous to that which the Southwest and West in the United States held to the Middle and Eastern Sates just after the Mexican War. The progress made in recent years proves that these territories can at least produce all that is requisite for the continuance of prosperity. The territory of Neuquén made gains in the matter of population (white and Indian in the proportion of three to one) to such an extent that it had recently about 30,000 white inhabitants, most of whom were Chileans, and about 10,000 Indians; and it was recorded that these 40,000 individuals possessed or were in the employ of those who possessed 195,000 cattle, 105,000 horses, 676,000 sheep, 170,000 goats and 7,000 mules. Considering only one item, we note that there were 16.9 sheep for each man, woman and child. Some progress has been made in the plans for rendering navigable the Santa Cruz River. In 1909 a steamer carrying many passengers and a cargo of 80 tons succeeded in going up against the rapid current of that stream as far as the Rincon Chico region, which was formerly regarded as inaccessible. The feasibility of plans for river improvement which shall enable larger vessels to come and go between the wide interior zone and the outside world has to be conceded. It is of highest importance to consider the agricultural possibilities of these very extensive regions, situated in latitudes that favor their development by the more vigorous classes of immigrants. The observation has quite recently been made that Argentina's expansion into the temperate southern regions of the South American continent is in its own way not less truly interesting than are the similar westward movements in the United States and Canada, the eastward one in Russia or the northward one of South Africa. This is Argentina's wide and deep frontier, the borderland in which pioneer conditions give place to rapidly growing settlements, and scientific methods convert supposedly useless areas into sources of economic wealth.

Argentina's Chief Agricultural Products. —At this point it is desirable to form correct and very distinct impressions in respect to each of the items that stand at the head of the list of agricultural products. We begin with the wheat. It will be seen that wheat, representing 57 per cent of all cereals produced in the republic, covers approximately 17,000,000 acres of land; but if labor were available no less than 80,000,000 acres could at once be brought under the plow for its cultivation. There is a decided tendency to increase the area of wheat-sown lands toward the south, where the climatic conditions are even more favorable — a tendency attributable to the new shipping facilities at Bahía Blanca.

With the steady encroachments of tillage upon the pasture the need for opening up fresh areas is making itself felt. The vast available tracts of unoccupied lands could, of course, be utilized for stock-raising, but the indigenous grasses are too coarse and unpalatable for forage purposes. These coarse grasses will have to be replaced by the fine shórt grasses growing in the lowlands, and gradually superseded by alfalfa, rye, barley and oats. These changes

cannot be effected without a considerable outlay of capital, which may in turn enhance the already high prices of cattle.

The fertile region lying north of the province of Buenos Aires, close to the banks of the Paraná — at one time the realm of herds and flocks — is to-day the principal centre of maize cultivation. Levee work is in progress on one of the islands in the Paraná River near Rosario with a view to preventing inundation at the period of floods. Should the venture prove successful considerable land will be reclaimed on this and on other islands where the soil is very fertile. It is estimated that these reclaimed lands are worth $100 per acre.

A recent issue of 'The Argentine Year Book' contains the statement that improvement in the grade of cattle has been brought about by the importation of pedigree animals valued at $8,000,000 in about 13 years. The essentially cattle-breeding zones are now to be found in the provinces of Entre Ríos and Corrientes. Here the climate, the pastures and the watercourses are ideal features that have insured the lasting prosperity of this pastoral zone, in which the old meat-packing industry still survives the advent of the large modern factories. The pastoral industry is, as we have said, extending into Patagonia, which is already being covered from the Cordillera to the Atlantic, with flocks that promise to be the best in the republic. The Argentine Republic annually produces in the neighborhood of 300,000,000 pounds of wool, 75 per cent of which comes from white-faced, long-wool sheep, Lincolns and Leicesters, and is known in the world markets as Argentine crossbred. When sorted, this wool grades largely into coarse and medium crossbred, corresponding to domestic commons and domestic one-fourth bloods in the United States. The fine crossbred of Argentina is known in the United States as domestic three-eighths blood. Merino fleeces form 20 per cent of the yearly total, producing wool that is graded as domestic fine in the United States. The remaining 5 per cent is wool of black-faced and domestic sheep. The average weight of the fleece is 5.3 pounds. Previous to the war France and Germany were the principal buyers of the wool crop, but the United States has now become the principal purchaser, taking 152,330 bales (925 pounds) of the 298,939 bales exported in the year ending 30 Sept. 1916. This industry in Santa Cruz is represented by 5,000,000 sheep, which yield 12,000 metric tons (2,204.6 pounds) of wool, all of which is exported. Within the last 30 years the area devoted to linseed has increased 20 fold. Argentina is to-day the largest linseed producer in the world. Although the plant can be grown in nearly any part of the republic, its cultivation is confined mainly to the territory of Pampa Central and to the provinces of Buenos Aires, Santa Fé, Entre Ríos and Córdoba.

The richest alfalfa fields are to be found on the immense pampa plains. The cultivation of alfalfa has assumed vast proportions, as will be seen from the following figures: 1872, 264,500 acres; 1888, 585,000 acres; 1895, 1,780,000 acres; 1912, 13,501,500 acres; 1914, 16,725,250 acres. This forage plant, which is displacing the native grasses, grows so rapidly when favored by the weather that three or four crops are easily obtained. Its yield is six to eight tons per acre. Formerly all the alfalfa grown was consumed in the country, but it is now being exported to Brazil.

Large tracts of land in the northwestern section of the country are well adapted to cotton, but the crop has made little progress. Most of the cotton grown comes from the territory of Chaco. It is also grown in Córdoba, Santa Fé and Corrientes. The annual production is about 1,230,000 pounds, of which about 60 per cent is exported. About 71,536 acres were planted under beans in 1914, but although a primarily agricultural country, Argentina is dependent to a large extent on imports for its supply of beans, peas and chick-peas. Rice is produced to the extent of 15,000,000 pounds annually, which is only 14 per cent of the rice consumed in the republic.

When discussing the general outlook in a year (1914) of depression in the land market, the 'South American Year Book' for 1915 published the following:

"As a general rule, land values in the Argentine are below those current in other countries less favorably situated as regards fertility, climatic conditions and accessibility to markets, and that being so, it would be only a matter of time when prices would revert to their old level. Every year the land is becoming more and more closely settled and its productive power increased and the country is in the happy position of having a practically unlimited market for its staple commodities."

If we desire to found our opinions in regard to the permanence of the agricultural prosperity of a large country even in part upon the statistics of production (a procedure always attended by risk of error), we must at least examine the figures that relate to long periods of time and to years in which fairly normal conditions prevailed, rather than to a single year, or to two or three recent years alone, in which the conditions may have been exceptional. With this rule in mind we may now revert to the Canadian-Argentine comparison, and may mention the suggestive and somewhat propagandist statistics prepared by Señor Lahitte, chief of the Bureau of Agricultural Statistics and Rural Economy for the Ministry of Agriculture of the Argentine Republic, which show that the increase in land farmed in Canada between 1871 and 1891 was 75 per cent; the increase in the area devoted exclusively to the cultivation of cereals in Argentina between 1895 and 1909 was 284 per cent. Such figures arrest attention, especially because the inhabitants of the two countries compared are about equal in number. The increase in the number of hectares (one hectare = 2.47 acres) of cultivated land in Argentina since the first year of independence is shown as follows: From 1810 to 1888, only 2,300,000 hectares; from 1888 to 1910, nearly 17,000,000 hectares. Exported products of stock farming alone were valued at only $3,300,000 in 1822 and at $71,075,955 in 1888, but in 1915 their value was $218,780,485. From statistics prepared in the year 1914 (Department of Agriculture, Argentine Republic; Ricardo Pillardo, Director-General, Commerce and Industry) we extract the returns of the

four principal products of the arable regions, showing that Argentina exported as follows:

	In 1904
Wheat	$66,947,891 gold
Maize	44,391,196 gold
Linseed	28,359,923 gold
Oats	541,973 gold
	In 1913
Wheat	$102,631,143 gold
Maize	112,292,394 gold
Linseed	49,910,201 gold
Oats	20,447,278 gold

Summarized, the value of exports of these four products increased during that decade from $140,240,983 gold in 1904 to $285,281,016 gold in 1913. In 1916 there were 16,088,963 acres under wheat, 3,207,411 acres under linseed and 2,525,402 acres under oats. The official estimate, published 17 Dec. 1916, places the wheat yield for 1916 at 77,393,258 bushels, linseed 5,280,071 bushels and oats at 33,610,157 bushels. Exports of linseed from 1 Jan. to 7 Dec. 1916 amounted to 619,210 tons, of which the United States took 209,337 tons.

Another comparison was suggested to the writer in the course of studies he made in the province of Buenos Aires and in the Paraguay-Paraná-La Plata regions between Asunción and the city of Buenos Aires, namely, the comparison with the pastoral industry of Australia, that country which rivals Argentina in flocks and herds, as clearly appears from the fact that Australia at the close of 1904 possessed 65,822,918 sheep, 7,868,520 cattle, 1,595,256 horses, etc.; and, thanks to the characteristic Australian rapidity of increase at the end of 1911 the number of sheep in the commonwealth was 93,003,521; of cattle 11,828,954, and of horses 2,279,027. In regard to this matter the writer was glad to avail himself of the testimony of those who have engaged in this industry on a large scale in both countries; and there seems to be no doubt that, tested by such practical experience, the conditions in southern and central Argentina are found to be unsurpassed.

Unquestionably the main support, and a very substantial one, of Argentina's leadership in varied or mixed agriculture is her possession of good, fertile soils, in flat or nearly level areas of vast extent, grass-grown and not covered with forests that have to be cleared away, easy of access, lying open and ready for the plough in regions so temperate, as a rule, that agricultural work can proceed almost without interruption throughout the entire year and cattle can be kept always in the open and at pasture. Invasions of locusts occur and in the past have proved to be exceedingly destructive; but preventive measures can in the long run so reduce the injury from this source that it will become a negligible quantity. Irrigation is required in many sections, though it is true that in the rich alluvial central basin of the valley of the Rio de la Plata the annual rainfall averages 30 inches; but it is demonstrable that irrigation constitutes a better and much safer reliance for the farmer than mere rainfall in every region not mountainous and not occupying an exceptional position with respect to permanent air and water currents. From Rio Negro to Misiones, in the sub-tropical northeast, and to Jujuy and Catamarca, in the Andean Northwest, soils of excellent quality and great or sufficient depth have been known, or cultivated successfully without knowledge, for many years; and, as we have seen, we are at liberty to entertain a favorable opinion in regard to soils in the Argentine Patagonian territories.

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MARRION WILCOX.

7. **COMMERCE.** In the year 1915 Argentina's imports amounted to $218,951,000 and exports to $539,000,000, while in 1916 the value of imports was $211,310,688 and of exports $453,841,507. In 1914 the total foreign trade, exclusive of coin and bullion, was $602,439,880 (U. S. gold), that being the sum of imports to the value of $263,663,363 and exports, $338,776,517. More nearly normal was the year 1913, the last wholly normal year before the European War, in which, according to the official report of the statistical office, the total foreign trade of the republic was $877,711,376 (U. S. gold, equivalent to 904,857,089 pesos), that being the sum of imports valued at $408,711,966 (421,352,542 pesos) and exports $468,999,410 (483,504,547 pesos). In 1913 the imports from Great Britain were valued at $126,959,989; from Germany, $69,172,279; from the United States, $60,171,867; from France, $36,933,537. To Great Britain in the same year the exports were, in value, $11,756,777; to Germany, $56,178,368; to France, $36,586,981; to the United States, $22,207,965. The chief imports are: Food products, textiles and allied products, manufactured articles of iron and steel, railway supplies, agricultural implements, electric apparatus, glass and chinaware, chemicals, building materials, manufactured articles of hides and skins, oils and beverages. The chief exports are products of agricultural and pastoral industry, of the forests and of the mines.

During the decade 1904–13, commercial progress on the part of Argentina, Uruguay, Chile and Brazil has been especially noteworthy; and we learn by consultation of the official data that the percentages of increase are as follows: Argentina, slightly more than 108 per cent increase; Uruguay, 104 per cent increase; Chile, slightly more than 94 per cent increase; Brazil, 54 per cent increase. Argentine exports (with values in gold dollars) in a single year preceding the outbreak of the war in Europe are listed as follows: Live-stock, $8,770,045; meat, hides, wool, etc., $136,336,218; manufactured animal products, $18,124,419; by-products, $2,569,451; agricultural products (in the restricted sense, products of tillage or of the field and garden), including raw material, manufactured and by-products, $301,267,094; woodland products, $10,617,985; products of the chase, $1,816,911; mineral products, $194,690; other products, $3,807,734.

Of the cereals, Argentina exported 592,797 tons of oats in 1915, 74,899 tons of barley, 4,921 tons of rye, 4,330,594 tons of corn, 2,511,514 tons of wheat and 116,049 tons of corn meal. The exports of frozen beef reached a record figure in 1916, while the exports of mutton were less than in any year in the last five-year period. The shipments of chilled and frozen beef in 1916 were 47 per cent more than in the last normal year, 1913.

Argentine imports, value in gold dollars, during the same year were: Live-stock, $1,419,290; animal foods, $6,572,463; vegetable foods and fruits, $2,583,251; spices and condiments, $8,098,967; vegetables and cereals, $6,727,848; substances for infusions, etc., $9,517,360; flour, macaroni, bread, etc., $1,434,066; tobacco and manufactures of, $7,038,055; wines, $9,866,310; spirits and liquors, $3,022,088; other drinks, $1,153,760; textiles, raw and manufactured, $89,560,214 (this includes silk, $7,080,063; wool, $16,751,832; cotton, $41,407,338, and sundries, $24,320,981); vegetable and mineral oils, $23,778,916; chemical, medicinal and pharmaceutical substances and products, $15,193,658; paints and dyes, $2,535,437; timber in bulk, $4,252,600; timber worked, $6,576,339; paper and pasteboard, $6,011,345; sundry paper manufactures, $3,890,640; leather and manufactures of, $4,610,560; iron (raw material), $24,149,251; iron and steel manufactures, $25,891,054; other metals unwrought or manufactured, $14,257,919; agricultural machinery, sacking, seeds, etc., $9,124,632; railway material, vehicles of all classes, etc., $37,223,336; stone, clay, glass, $36,577,913 (including raw material, $31,640,937, and manufactured, $4,936,994); building material, $35,775,580; electrical supplies, $10,110,088; sundry articles and manufactures, $14,399,584. The foreign trade of Argentina in 1916 amounted to 760,755,161 gold pesos ($733,748,324), of which imports represented 217,409,322 pesos ($202,940,400) and exports 543,345,839 pesos ($524,057,350). This gives the country an apparent favorable balance of trade of 325,936,517 pesos ($314,365,752).

Commerce with the United States.— In 1915 the exports from the United States to Argentina were valued at $53,912,544. The record of Argentina's commerce with the United States during 20 years (1895 to 1914, inclusive) shows a very marked preponderance of imports over exports, except in the first and last of those years. Thus, in 1895 Argentina imported from the United States goods valued at $6,419,519, and exported to the United States goods valued at $8,589,278; and in 1914 the figures were $35,585,913 for imports and $41,680,985 for exports. But in the years that intervened the balance of trade in favor of the United States was conspicuously large. The importance of the Argentine market will be most readily appreciated when we ascertain, from a study of the records for the year 1913, that the value of merchandise exported from the United States to Argentina was nearly (within $7,430) as great as the value of merchandise exported from the United States to Brazil, Uruguay, Paraguay and Ecuador combined; and that it was $12,543,939 greater than the sum of exports from the United States to Chile, Colombia, Peru, Venezuela, British Guiana, Bolivia, Dutch Guiana, French Guiana and the Falkland Islands. In brief, Argentina received 36.2 per cent of the total exports from the United States to South America. The principal articles thus supplied by the United States to Argentina were: Iron and steel, raw material and manufactures of 33.4 per cent of total supplied by the United States to South America; wood and manufactures, 62 per cent of total; oils — animal, mineral and vegetable, 39.8 per cent of total; agricultural implements, 82 per cent of total; cars, carriages, other vehicles and parts of, 35.8 per cent of total; leather and manufactures of, 42.5 per cent of total; fibres, vegetables and manufactures of, 74 per cent of total; engines, locomotives and railway material, 21.1 per cent of total; aeroplanes, automobiles, bicycles, motor and other cycles, 38.5 per cent of total; chemicals, drugs, dyes and medicines, 36 per cent of total; naval stores, 36.4 per cent of total; paper and manufactures of 44.6 per cent of total; other goods of minor importance, 14.9 per cent of total. According to the Argentine commercial statistics of 1913 goods to the value of $22,135,215 from the United States were received duty free. It is necessary, however, to emphasize in this connection the fact that among the seven nations that lead in exports to Argentina, the United States took only a third position, surpassed by Great Britain and Germany and followed by France, Italy, Belgium and Spain, until there came the enormous increase that characterized the years 1913–17, inclusive, and which was due to the vast decrease in production of the European countries because of the war.

In 1916 the United States imported from Argentina articles valued at $100,000,000, approximately, and the value of exports from the United States to Argentina in 1916 was about $65,000,000. Consult *Americas, The* (New York, published monthly, 1914 et seq.); 'Argentine International Trade' (Panama-Pacific Int. Exp., 1915, Buenos Aires, Department of Agriculture, 1914).

MARRION WILCOX.

8. MINING AND MANUFACTURING INDUSTRIES. Although it is true that gold, silver and copper have been mined in a small way from early times, the mining industry in Argentina has not been developed to any great extent. It is often said that the main reason is the total lack of manual labor; that the mineral outcrops are found in the Andean

region where labor is scarce; that the mineral zone has an area of 48,000 square miles and is inhabited by only 20,000 people, living mostly in or near the town of San Rafael; and that a large area is altogether unpopulated. The means of communication (as stated in consular reports, etc.,) are insufficient, and on those lines that do exist a prohibitive freight is exacted. Writers mention districts "reported to contain" copper, petroleum, silver, iron, borax, sulphur, gold and tin. But it is quite safe to say that districts which are with certainty known to contain such things in paying quantities do not remain unpopulated or wholly unprovided with manual labor. Means of communication are provided readily enough in any part of the republic that particularly requires and can make uncommonly good use of them; in fact, the capitalists interested in Argentine railway development are especially alert. The conclusion is that mines which are referred to in such terms are not of sufficient value to attract capital and labor for their development. But in Córdoba province (which has a large population and railways) copper, silver, gold, marble and lime are found. Jujuy has mines of gold, silver, copper, mercury, borax, salt and asphalt. Other mining districts are those of the province of Salta, which have kaolin, beside the minerals found in Jujuy. Similarly the provinces of Catamarca, Rioja and San Juan have mineral products. Mining of marble and wolfram is the principal industry of San Luis; Chubut and Mendoza produce coal and petroleum. In 1915 there were 15 petroleum wells; petroleum is exploited by the government and eight private companies; gold is found in Tierra del Fuego, Santa Cruz and Chubut. See COMMERCE (Article 7).

Nearly all the important branches of human industry are represented in the period of development that began after the year 1875. Manufacturing establishments at the present time produce standard varieties of food, clothing, building material, furniture, etc., to a limited extent; but the republic, agriculturally so powerful, is both willing and able to continue to be a purchaser of such manufactured articles as can be produced more correctly and at less cost in the United States and in Europe. Naturally the preparation of products of agricultural and pastoral industries for domestic and foreign markets increases rapidly, favored by wholly exceptional conditions. Flour and sugar mills are in vigorous and profitable operation, and the dairies have increased remarkably. There are 525 creameries, 16 butter factories, 129 cheese factories, etc., a total of 1,259 establishments connected with dairies. During the last reported year over 35,000,000 pounds of cream were produced, 20,000,000 pounds of butter, and 12,000,000 of cheese. The estimated value of these products was about $8,000,000. The production of sugar and wine tends to increase, the annual output now exceeding 230,000 tons of the former and 500,000,000 quarts of the latter. Tucumán has 72 per cent of the registered sugar mills of the republic. Mendoza is the centre of the wine district. Important also are the tanneries (about 200 in number), the manufactories of cigars and cigarettes, of furniture, etc. But it is a mistake to speak of Argentine manufactures and mining as though they ranked with Argentine agriculture. They do not; and their attainment of such rank in the near future is highly improbable. According to the last industrial census, there were 31,988 factories in Argentina, employing a total of 329,490 persons. The total capital was $727,591,135, and the output was valued at $1,227,549,196.

According to an industrial census taken in 1914, Buenos Aires at that time had 437 shoe manufactories, which gave employment to 9,970 workmen and consumed raw material valued at $8,460,418, of which $5,854,172 worth was domestic and $2,606,246 imported. The combined annual sales of these factories amounted to $16,448,514. It is estimated that the industry in Buenos Aires represents approximately 75 per cent of the total for the country.

MARRION WILCOX.

9. BANKING AND FINANCE. The first important operation of credit made by Argentina was a loan negotiated with Messrs. Baring Bros. & Co., of London, in the year 1823, bearing interest at the rate of 6 per cent and 2½ per cent amortization, issued at 90 per cent. Shortly after this operation, internal political troubles caused the suspension of interest; and not until many years after, during the administration of President Mitre, did the republic resume the service on its debt. Eventually the stockholders of the bonds received their full capital and interest in new bonds. During the years 1883 to 1885 many of the Argentine provinces issued loans in order to assist in establishing national banks under a special national law. A number of these provinces negotiated their loans in Europe, principal with French bankers. Unfortunately, owing to the crisis in 1890, the provinces suspended service of interest on these loans, the country suffering at the same time a great crisis; and although the national government, during the presidency of Dr. Pellegrini, who is remembered as an able statesman, endeavored to continue the service in cash, it could not do so. At that time Dr. Victorino de la Plaza (subsequently President of the republic) transmitted to Buenos Aires sound financial views prevailing in London, and by his counsel the funding loan was issued to pay service in bonds instead of cash for five years. Before the expiration of that time the country renewed the normal service in cash of its entire debt. Soon afterward the national government decided, in the interest of the credit of the country, to make arrangements to assume the loans created by the provinces, giving national bonds in exchange for the provincial bonds; and thus the loans issued by the different provinces, as we have mentioned above, were withdrawn. The same thing was done with the railway guaranties, under national laws, given for the construction and equipment of lines. In consequence of the financial crisis of 1890, these guaranties were not punctually paid, and it was decided to treat this question in a radical way by computing the value of each guaranty and giving to the railway 4 per cent national bonds. Fifty million dollars assigned to this purpose are known as national railway bonds. The credit of the Argentine Republic, thus completely re-established, has been maintained during a long period without an interruption, notwithstanding the difficult moments experienced

in the years 1914–16 over all the world in consequence of the European War. It is but just and right to mention in this connection the able manner in which the President, Dr. de la Plaza, controlled the finances of the country.

Aid Extended by British and American Bankers.— Nearly all the loans made by the Argentine Republic were issued under the auspices of Messrs. Baring Bros. & Co., who have been the friends and bankers of the country from the beginning, and have won the respect and the sympathy of all the Argentine people. Many of the principal loans of the republic were issued solely for the construction of railways, water and drainage, portworks, and other improvements, all of which belong to the national government and earn enough to pay the service.

American bankers have had until quite recently little direct negotiation with Argentina. Messrs. J. S. Morgan & Co., of London, issued a loan jointly with Messrs. Baring Bros. & Co., in 1886–87; again, but on this occasion unaided, issued the funding loan of 1890; and also organized and retained a large interest in one of the railway companies, the Argentine Great Western Railway, now known as the Pacific Railways. The only direct loan contracted with American bankers was one for $10,000,000 made by the province of Buenos Aires in 1882 with Messrs. Morton, Bliss & Co., who took the whole amount. This loan, according to the statement in Don Pedro Agote's book on finance, was the first Argentine loan issued at par, and was brought out in the London market. The same firm, afterwards the Morton Trust Co., now the Guaranty Trust Co., of New York, has maintained intelligent interest in and continued its friendly relations and financial connections with Argentina. Compare the memorandum on the finances of Argentina submitted by Dr. Samuel Hale Pearson, in Proceedings of the First Pan-American Financial Conference (Washington 1915).

Since the loan of 1882, the first financial operation of marked and conspicuous importance negotiated with the banks of the United States was an advance for a short period of $15,000,000 made in 1914 by the National City Bank of New York and its associates. Its sequel was the new issue made in 1915 by the same bank and its associates for a further amount of $25,000,000, the object of the second issue being the retirement of the first advance of $15,000,000; and it must be understood that the issue by the National City Bank and its associates was part of a loan of $50,000,000 of which Messrs. Baring Bros. & Co., of London, issued the other half in London. With this loan for five years, a number of small advances have been retired.

La Caja de Conversión was created by national law in the year 1896. Its duties have relation to the exchange of used notes for new; the receipts of gold and issuance of paper money for its legal value (44¢, gold, per dollar), or, vice versa, the conversion of paper into gold at the same rate; the exclusive control of the printing and issuing of the currency of the country, etc. When the Caja de Conversión was created the circulation of currency in the republic was about $300,000,000, but to-day it is about $600,000,000; the gold value is about $425,000,000, and against this there is in the vault nearly $300,000,000, or about 70 per cent of the notes issued.

Development of Argentine Banking.— And now a few words in regard to the Argentine banking system. During the early years of the independence of the country a number of banks were established, although the old Bank of the Province of Buenos Aires, founded in the year 1802, continued to lead them all. This was a bank of issue, having fiscal privileges, and became a very powerful institution. It was, indeed, the pioneer and founder of the wealth of the country, its useful practice being to loan its money at low interest, with a 5 per cent amortization each three months, to the farmers and owners of land, enabling them to improve and develop the ranches. By such means did the principal land owners of Argentina make their fortunes. This bank had close relations with Messrs. Baring Bros. & Co., and became very powerful, having large credits in London and controlling the exchange market for many years; nevertheless the financial and political crisis of 1890 caused its suspension, and years passed before it was reorganized with a capital of $30,000,000. To-day it is half-owned by the province of Buenos Aires and half by private shareholders. In the year 1873 a group of wealthy citizens organized a national bank, the government contributing half of the capital, and for many years this was a powerful institution, helping the development of Argentine industries, such as the sugar in Tucumán, the wine industry in the provinces of Mendoza and San Juan, and agriculture in the province of Santa Fé. This institution also experienced financial difficulties in the crisis of the year 1890. During Dr. Pellegrini's administration, in the year 1891, the Banco de la Nacion Argentina was created, with a capital of $50,000,000 currency (this bank taking over the liquidation of the Banco Nacional). It is an entirely official bank, and one of the articles of its "law of creation" contains the provision that all the net profits are to be applied to the increase of its capital. To-day that capital has reached the sum of $128,000,000 paper, equivalent to over $60,000,000, currency of the United States, and the bank has besides a reserve fund of $14,500,000 in gold. The management does not sustain such relations of dependence upon the national government as the circumstances that the directors are named by the President of the republic, and their nominations require confirmation by the national Senate, would seem to indicate. It has over 150 branches in Argentina and is constantly increasing the number, following the growth of the nation. It has no agencies abroad, although its financial relations with the principal banks and bankers of the world are being increased every year, and it now has very friendly relations with some of the principal banks of the United States. Its deposits have reached over $300,000,000 gold, and during the universal financial difficulties of 1915 it helped the commerce and industry of the republic, which would otherwise have suffered more severely from the restriction of credits caused by the war.

Beside the Bank of the Nation and the banks of the province of Buenos Aires to which we have referred, there are several private banks, formed solely with Argentine capital,

which are very prosperous institutions and have been created as the requirements of the country demanded, such as the Banco Español and Banco de Italia del Rio de la Plata, whose combined capital is over $80,000,000 (gold). There are also several foreign banks which have aided materially in the development of the trade of the country. One of the first of these was the Bank of Maua (now liquidated), established in Buenos Aires and Montevideo about 1855. The very important London and River Plate Bank was founded in the year 1862. Since that date the following have been established: The London and Brazilian Bank, The British Bank, Anglo-South American Bank, two German and several other banks, including Italian, Spanish and Dutch, with a total capital of about $300,000,000. The most recently established is the agency of the National City Bank of New York.

The National Mortgage Bank is strictly a governmental institution managed by a board of directors appointed by the President of the Republic and confirmed by the Senate. This bank issues national cédulas (real estate mortgage bonds). The transaction must not in amount exceed 50 per cent of the value of the lands. Loans are limited to $250,000 to any one person. These cédulas bear either 5 or 6 per cent interest, and, because this bank is a national institution, have the guaranty of the Argentine Republic. Some of the first issues were of 7 per cent, but all have 1 per cent amortization. They were principally held in Belgium, having been one of the favorite investments of the Belgian public. The total amount of cédulas issued is in the neighborhood of $200,000,000.

Argentine finances suffered from a crisis that began in 1913 and went on with increasing stress until the end of 1914 and the early months of 1915, when conditions began to improve. The European War was, of course, a tremendous shock, which further unsettled the financial structure of the country, but which offered some compensating advantages in the form of increased demand and higher prices for the food products which Argentina was so abundantly able to supply. The situation in 1915 improved rapidly, and in 1916 decidedly favorable tendencies prevailed.

The national finances, collection of customs, stamp taxes, disbursements, and the service of the public debt are entrusted to the Department of Finance; and the conversion office (Caja de Conversión) is charged with the maintenance, as we have said above, of the proper relation between gold and paper money, besides having in its care the national archives, the bureau of statistics, the national chemical office (established to enforce the national pure food law), the custom-houses, ports, and all banks.

The basis of the monetary system of Argentina is the gold standard. The unit is a gold peso, divided into 100 centavos, weighing 1.6129 grammes of gold .900 fine, or, say, 1.4516 grammes fine gold. Its par value, expressed in terms of United States currency, is $0.96475. The parity of $1 United States currency in terms of Argentine gold pesos is $1.0365. The actual currency of Argentina is government notes, to which a value of 44 per cent of the gold peso has been assigned by the government. This parity of 44 per cent is maintained through the medium of a conversion fund which exchanges gold for paper, and vice versa, on the basis of $44 gold for $100 paper, or $227.27 paper for $100 gold. Therefore, since the value of the paper peso is fixed by governmental decree and is maintained through the conversion fund, the paper peso represents 0.6387 grammes of fine gold, and its parity expressed in terms of United States currency is $0.4245. The parity of $1 United States currency in terms of Argentine paper pesos is $2.35576 *curso legal* (paper currency). Bills of exchange on foreign countries are quoted in both paper and gold, but usually they are quoted in gold. When Buenos Aires quotes New York exchange on the basis of paper currency, the quotation represents the equivalent in United States currency of $1 paper peso. Thus, 42.50 means that $0.4250 United States currency is the equivalent of $1 peso, paper. When Buenos Aires quotes New York exchange on the basis of the gold peso, the quotation is expressed in gold pesos; thus, "New York sight $1.0375" means that $1.0375 Argentine gold pesos equal $1 United States currency.

The trade balance in favor of Argentina in 1915 was noteworthy: 331,000,000 Argentine gold pesos. Failures in the republic during the recent period of financial crisis are summarized as follows: Year 1912, assets $95,000,000 and liabilities $82,000,000; year 1913, assets $200,000,000 and liabilities $173,000,000; year 1914, assets $603,800,000 and liabilities $422,800,000; year 1915, assets $233,500,000 and liabilities $178,000,000. These figures, supplied to us by the courtesy of the National City Bank of New York, clearly demonstrate both the stress and the recovery mentioned above. The budgets at hand give us: Total estimated ordinary revenue for the year 1913, $342,292,894.54 *curso legal;* and for the year 1914, $361,773,132. The new budget, signed 22 Feb. 1917, appropriates the same amount as in 1916, namely, 381,000,000 paper pesos ($161,772,600). The latter proved to be excessive. The income for custom houses and port services during 1916 amounted to $118,587,979, against $108,929,011 for 1915, and $133,352,488 for 1914. The total debt of the republic, 31 Dec. 1911 was $526,540,088 gold; at the end of 1912 it was $532,398,699 gold; on 31 Dec. 1913 it amounted to $544,820,000 gold; and on 31 Dec. 1914 it was $545,023,470 gold. We must add to the total for 1913 about $100,000,000 gold in order to approximate the amount of the public debt in 1915 and 1916.

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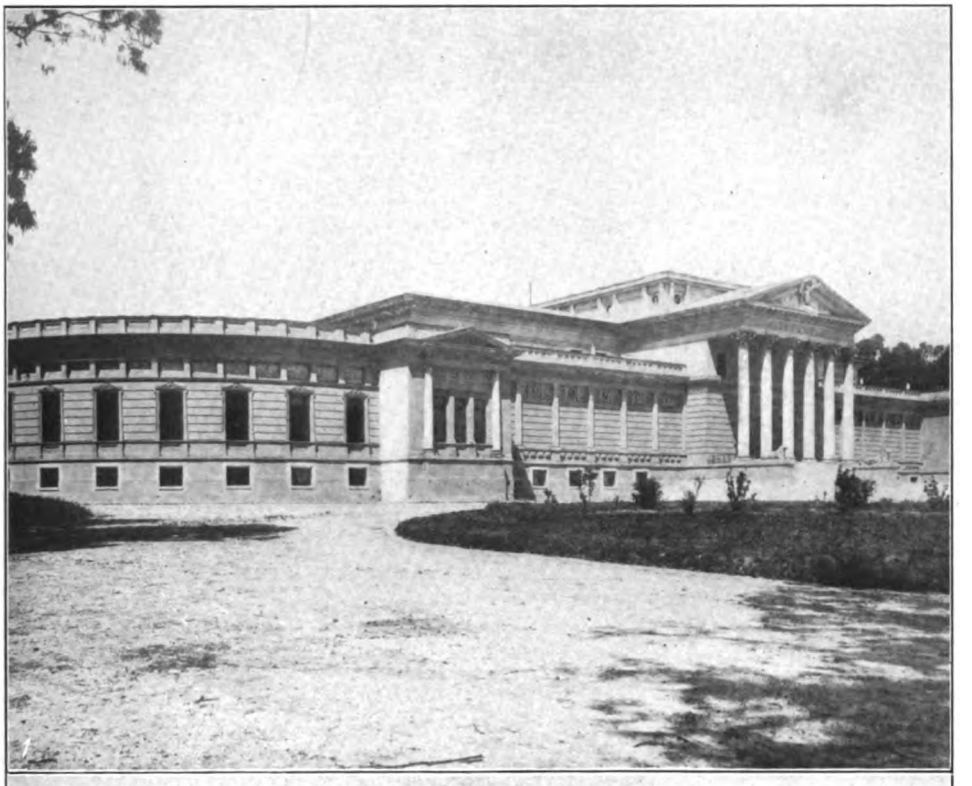
MARRION WILCOX.

10. NATIONAL WEALTH. Dr. Albérto Martinez, director of the last national census of Argentina, has estimated the aggregate wealth of the people of Argentina at 34,260

ARGENTINA



1 Museum of the University of La Plata

2 Astronomical Observatory (La Plata University)

ARGENTINA

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1 Municipalidad "La Plata"

2 Theatre Colon, Opera House in Buenos Aires

million paper pesos in 1916, or $14,546,796,000 (American currency), as against the small sum of only $2,740,600,000, the estimate of the census of 1895 which appears to have been somewhat incorrect.

Property of a private character, owned by the state, is valued at $1,126,000,000, showing an increase of nearly $850,000,000, as compared with 1888. The industrial property of the state was estimated at $480,000,000 in 1914, as against $53,000,000 in 1884. It consisted of the following items in 1914: Sanitary works, $145,000,000; State railways, $136,000,000; port works, $168,000,000; irrigation works, $15,000,000; hydraulic works, $12,000,000; telegraphs, $4,000,000. In 1888 the government lands were valued at $104,000,000 (301,000,000 acres at 34.4 cents per acre). By 1914 their value had increased to $220,000,000, although their area in the meantime had been reduced to 205,000,000 acres, the value per acre evidently being estimated at $1.07.

The bulk of the people's wealth is represented by agricultural property, the value of which is estimated at $7,218,200,000. Industrial, factory and shop properties are estimated at $758,760,000. It is noted that 75 per cent of the raw materials employed by the industries is of domestic origin. Argentine industries supply 71 per cent of the demand for manufactured articles. Reckoning the population at close to 9,000,000, and the aggregate wealth at $14,546,796,000, the wealth per capita — statistical average — is $1,616.

Another estimate of the national wealth was made in 1917 by Dr. Alejandro E. Bunge, director general of the National Bureau of Statistics. He gives the following estimates of Argentina's national wealth for the years 1908 and 1916:

Form of wealth	1908	1916
Lands and grounds	$2,758,000,000	$4,510,000,000
Fixed investments	267,000,000	456,000,000
Cities and villages	2,547,000,000	2,887,000,000
Personal and household effects	637,000,000	722,000,000
Live stock	628,000,000	1,360,000,000
Agricultural products	530,000,000	530,000,000
Industrial products	637,000,000	700,000,000
Agricultural implements and machinery	78,000,000	172,000,000
Industrial machinery	170,000,000	187,000,000
Stock of gold	168,000,000	338,000,000
Railways	890,000,000	1,433,000,000
Street railways, telegraphs, telephones, electricity, and gas works	255,000,000	290,000,000
Port works, canals ships	255,000,000	280,000,000
Total	$9,820,000,000	$13,865,000,000

The difference in the valuation of lands and grounds for the year 1916 and that for 1908, amounting to $1,752,000,000, or 63.5 per cent, does not represent a real increase in the value of land. No such increase in land values has taken place. The difference is to be explained by the difference in the methods of estimating values employed for the two censuses. The same holds true in regard to the valuation of live stock, the value of which is estimated at $628,000,000 for 1908 and $1,360,000,000 for 1916. The difference of $732,000,000 would represent an increase of 116.5 per cent.

For the purpose of comparing the national wealth of Argentina with that of other nations the following table is submitted, showing the aggregate and the per capita wealth of the principal nations:

Country	Year	National wealth	Population	Wealth per capita
Argentina	1908	$9,820,000,000	6,050,000	$1,623
	1916	13,805,000,000	8,070,000	1,718
France	1908	55,391,000,000	39,280,000	1,410
Germany	1908	83,300,000,000	62,800,000	1,325
United Kingdom	1908	67,012,000,000	44,500,000	1,506
United States	1904	107,104,000,000	81,200,000	1,318
	1912	187,739,000,000	95,540,000	1,965

It should be noted, however, that these figures are not directly comparable. The purchasing power of money differs in different countries and, moreover, if the real economic power of a country is to be measured correctly it is necessary, in addition to the property existing within the boundaries of the country, to consider also the investments placed in foreign countries. The European nations in particular have enormous investments abroad, with considerable returns in the form of interest and dividends. This fact must be taken into account, particularly if a comparison of the taxable wealth of different countries is attempted. Argentina's foreign investments are nil, while millions of dollars have been invested by foreigners in her various public and private enterprises. Consult 'Tercero Censo de la República Argentina de 1914' (Buenos Aires 1916), and 'Commerce Reports,' issue of 29 Sept. 1917 (Bureau of Foreign and Domestic Commerce, Washington, D. C.).

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11. TRANSPORTATION AND COMMUNICATION. Shipping.— We shall first consider the shipping at the ports of the river system (La Plata, Paraná, etc.); and the magnitude of British trading interests in Argentina is one of the facts that will claim our attention immediately. The preponderating share of the United Kingdom in the sea-borne commerce of the Paraná-La Plata River system, as the 'South American Year Book' suggests, may be summed up in a single sentence: the number and tonnage of British shipping in Argentine waters exceeds that of all the other nations put together. So important is the sea-carrying trade of the British flag, and so keen has become the competition of foreign shipping, that even so slight a fall in the relative position of British shipping as one-half per cent before the European War began was commented upon by British writers as a not altogether propitious sign. Taking the shipping of all the ports of the river Plata as a whole, the tonnage of the vessels owned by British subjects represented in 1912 no less than 3,557,700 tons, or 60½ per cent of the total shipping, but compared with 1911 there was a falling-off of 97,000 tons to be recorded. In the year last mentioned the British tonnage attained 3,654,700 tons, or 61 per cent of the tonnage of all nations. Germany took the

second place with 661,400 tons, followed by Italy with 426,500 tons, and France with 400,000 tons. Germany and France were credited with an increase of 16,300 and 46,990 tons respectively; the Italian flag showing the considerable decrease of 140,300 tons, as a result of the utilization of liners as transports. Under the Argentine flag we find 78 steam vessels with 43,001 tons, and 9 sailing vessels with 7,052 tons. At the Atlantic port of Bahía Blanca, during the normal period before August 1914, the number and tonnage of British vessels nearly doubled in the short space of a single year. Practically all the important shipments here were made in British vessels, notwithstanding the efforts of Germany to secure a footing in this trade. Rapid travel has become a necessity in Argentina as elsewhere. Competition between the various steamship companies for fast services between Argentine ports and Europe has become keener than ever.

The efforts of the government to foster the Argentine coasting trade have accomplished, unfortunately, very little. As for river communication, some progress is now being made and the communications with Paraguay by the Paraná River are gradually improving. There is a service of rather light-draft steamers from Buenos Aires as far as Asunción, while transit by water between the capital and Rosario, to which port on the Paraná River ocean-going steamships ascend, is beginning to compete advantageously with the railways. From a handbook prepared by the Pan American Union ('Argentine Republic,' Washington, D. C., 1916) we quote as follows: «Austrian, Belgian, Brazilian, British, Danish, Dutch, French, German, Italian, Spanish and Swedish steamers arrive and depart regularly from the ports of Argentina to all quarters of the earth. There are 50 lines with agencies in Buenos Aires. Regular passenger service is maintained to the various ports of Europe and steamers leave or arrive several times a week. To New York, while there are not so many steamers, opportunity is offered at least once in a fortnight for the traveler to take a direct steamer.» Argentine official statistics show that since the year 1900 the total tonnage (entrances and clearings to and from ports of the Argentine Republic) have increased 124.2 per cent. In March 1917 a regular line of cargo steamers was inaugurated between Japan and Argentina and Brazil.

Railway Postal and Telegraph Services. — Argentine railways have at least one characteristic which distinguishes them from those of the other South American countries; each is part of a system designed to promote the development of the entire republic.

For a number of years practically all imports were sent to Buenos Aires, and thence forwarded to the centres of consumption. That made necessary the joining of Buenos Aires with all the interior districts by a number of radiating main lines. These help to develop the agricultural districts they influence, which in turn give them a large amount of traffic. Secondary lines are then interconnected and the points where such lines cross the original lines become in turn new centres. Subsequently, radiating lines were constructed from other important places also, such as Bahía Blanca, Rosario and Santa Fé, the shipping facilities of these foci being increased to accommodate the growing traffic. The result is seen in the present logically developed system which is uncommonly efficient and capable of almost indefinite expansion. Up to the beginning of the year 1914 there had been constructed and, as a rule, very well equipped, 20,502 miles of railways. Of these, 6,226 miles were of narrow gauge; 1,611 miles of standard gauge and 12,967 miles of broad gauge. Private corporations owned 17,351 miles, while 3,454 miles belonged to the state. The railway system was extended 391 miles during the year 1913. In 1915 there were open 22,688 miles of railways, of which 4,136 miles belong to the state. This railway expansion places Argentina in the ninth position, with respect to length of railways, among the countries of the world; more extensive systems exist only in the United States, Germany, Russia, France, India, Great Britain, Austria-Hungary and Canada. «The nation has realized,» says the 'Argentine Handbook,' «that to have a population to develop the rich soil of the country, the railway must go in advance of settlement. Surveys have therefore been encouraged and actual construction has been hastened into regions practically unvisited by man until then.» A phase of the railway development during 1913 was the practical completion of the line westward from the Port of San Antonio, in Rio Negro Territory, to Lake Nauhal Huapé; the plan being to extend this road into Chile through the neighboring Cordillera. The Southern Railway also has continued construction from Neuquén toward the Andes, and the intention is to cross into Chile not far from Valdivia.

The provinces of Buenos Aires, Santa Fé and Córdoba excel in the development of their railway systems; but each large political subdivision, except Los Andes and Tierra del Fuego, has at least some line built or building. The government by its plan of extension has carried its own lines into Jujuy, and thus to the Bolivian frontier, where connection is to be established with La Paz. Of international interest also was the inauguration and operation (1913) of a through passenger and freight service between Buenos Aires and Asunción, the capital of Paraguay. A law passed by the Argentine Congress in 1915 provides for the collection of a pension fund for railway employees. In 1912 a law was passed providing for the canalization of the Upper Uruguay; the work to be carried out jointly by Argentina, Brazil and Uruguay. A ferry boat service was also projected between Paraguay and Argentina at Posadas and Encarnación.

The so-called Mitre law, which went into effect 1 April 1908, is of great importance to investors in Argentine railways. Article 8 of that law states, with regard to railways:

The materials and articles for construction and operation which are imported into the country shall be exempt from import taxes, and this exemption shall be effective until 1 Jan. 1947. The company shall pay, during the same period, regardless of the date of its concession, a single contribution [tax] equivalent to 3 per cent of the net earnings of its lines, being exempted during same period

from all other national, provincial, or municipal taxes.

In 1906 the national Supreme Court decided that this law exempted the railway companies from the payment of any tax except the 3 per cent of their net earnings, the net earnings being assumed to be 40 per cent of the gross earnings; but it has recently revised its decision, and the municipalities are now attempting to compel the railway companies to pay several years' back taxes for paving, lighting, etc. Some of the railway companies are paying the municipal taxes under protest. The principal railway companies operating in the republic have asked Congress to pass a resolution enjoining the municipalities and provinces from collecting these taxes, and it is expected that the present Congress will decide definitely what interpretation is to be placed on the law.

The 3 per cent tax is expended on improvement to highways leading to the stations of the railway paying the tax.

The organization of posts and telegraphs was established by law in 1878. Argentina is a member of the Universal Postal Union, and the parcel-post convention with the United States was signed in September 1915. The mails receive systematic attention, and delivery is made to every place in the country. The number of permanent employees is about 13,500 and about 1,250,000,000 pieces are carried annually by railways, steamers, stage-coaches and mounted messengers. In May 1913, there were 43,202 miles of telegraph, with about 2,600 telegraph offices, employing more than 10,000 persons in the service. The revenue of the Postal Department was $4,967,910 for 1914–15. The government owns about one-half of the telegraph system and the provinces of Buenos Aires and Entre Ríos have lines. Cable service between Argentina and other countries is chiefly in the hands of private companies. By agreement with Bolivia, Paraguay and Uruguay, the charges to those countries are the same as the Argentine inland rates. Argentina was the first of South American states to adopt wireless telegraphy. There are 12 stations for wireless telegraphy. All ships with a crew of over 50 and touching at Argentine ports are compelled by law to be provided with wireless equipment.

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MARRION WILCOX.

12. ARMY AND NAVY. Military service is compulsory to all Argentine citizens for the nominal term of 25 years, between the ages of 20 and 45. By means of an annual drawing of lots conscripts of 20 years of age are designated to serve for one year (army) or two years (navy). Conscripts who can not read and write are taught during the term of military service. Those joining the army are also given instruction in agriculture. After the conscription service the citizens do not receive military training although they belong to the active army (first 10 years), then make up the national guard (following 10 years), and lastly the territorial guard (remaining five years). There is also provision for soldiers enlisting under contract, for citizens serving as a punishment for breach of the Military Law, and for voluntarily enlisted musicians. The standing army has 20 infantry battalions of three companies each, nine cavalry regiments of four squadrons each, five regiments of field artillery, each having four 6-gun batteries, one regiment of howitzers, some mountain artillery and heavy artillery, six battalions of engineers of two companies each, cyclist, administrative companies, etc. The army expenditure in 1915 was $28,334,556 paper.

The total establishment of the standing army was about 22,000 in 1916. The compulsory service was created in 1901 and since that time nearly 200,000 men have been trained.

All officers in the army are graduates from the military school at San Martin. Besides there are a Superior Military School, a Cavalry School, a school for petty officers, a school for marksmen, another for gunsmiths and an Aviation School.

In the navy the two-year conscription system provides the men for ordinary duties of the navy while officers are selected from the Naval School at Rio Santiago. In addition there are special training schools for mechanics, electricians, artillerymen, torpedo crews, stokers, clerks, wireless operators, pilots, sailors and ship boys. The entire fleet is mobilized for four months in every year and during that period a number of reserve men are called up for service. The reserve force consists of 12,000, of whom one-half belongs to the first reserve and the other half to the second. Before graduating as midshipmen the students of the Naval School spend the last year of instruction on board of a training ship making a cruise around the world. The war navy consists of 2 dreadnaughts, 2 pre-dreadnaughts, 4 armored cruisers, 3 protected cruisers, 2 armored gunboats, 2 torpedo gunboats, 15 destroyers, 8 torpedo boats and some miscellaneous craft.

MARRION WILCOX.

ARGENTINE, Kansas, formerly a city in Wyandotte County on the Atchison, Topeka and Santa Fe Railroad; annexed to Kansas City in 1910. It has extensive smelting interests, a structural steel company, zinc and chemical works, an ice plant, railroad repair shops and several grain elevators. Pop. at time of annexation, about 6,200.

ARGENTINE, the name of a group of small smelt-like fishes, living in the open seas of the north temperate zone, and distinguished by the brilliant, silvery appearance of their scales. Some ascend rivers to deposit their spawn, where they are caught in large quantities and eaten as a delicacy. This group is also famed for the abundance of nacre, the substance used in making artificial pearls, which is attached to their air bladders in the form of a coat of silvery fibres.

ARGENTITE (from the Latin, *argentum*, "silver"), a native sulphide of silver, belonging in the galena group, crystallizing in the isometric system and having the formula Ag_2S. It is opaque and has a metallic lustre and a dark, leaden gray color. Its hardness is from 2 to 2.5, and its specific gravity is about 7.3. Argentite occurs in many countries and when

found in quantity is a valuable ore of silver. It occurs in crystals (often distorted), massive, in crusts, and in thread-like aggregates. Choice speciments occur in the silver mines of Joachimsthal, Bohemia and Freiberg, Saxony; in Bolivia, Chile and Peru, and notably at Batopilas, Mexico; also in many silver mines in Colorado, Nevada, and elsewhere in the United States. Argentite is often called "silver glance" by miners.

ARGENTORATUM, an Old Celtic word, meaning "stones of Argantos," the old Roman name for Strassburg.

AR'GILLA'CEOUS ROCKS, a petrographic division including those rocks that are largely composed of clay. They owe their origin to the disintegration and decomposition of other rocks and hence are always of secondary nature. Among the common varieties belonging to this class are ordinary brick-clay, fire-clay, potter's-clay, kaolin, mudstone, shale and marl (qq.v.). Clay rocks are easily influenced by metamorphic agencies, yielding shale, micaschist, graywacke and other hard rocks. See SEDIMENTARY ROCKS.

ARGINUSÆ, är'jĭ-nū'sē, the name of several small islands southeast of the Island of Mitylene (Lesbos), now belonging to Greece. In their vicinity the Athenians, under Conon, 406 B.C., defeated the Spartans under Callicratides, in a hard-contested naval battle.

ARGIVES, or **ARGIVI,** the inhabitants of Argos; a term used by Homer and other ancient authors as a generic appellation for all Greeks.

ARGO, the important southern constellation of the Ship, which is nearly 75 degrees in length, and contains over 800 stars visible to the naked eye. It has been subdivided into the smaller constellations: Puppis (the Poop), Vela (the Sails) and Carina (the Keel). Canopus, a star of the first magnitude, is its chief ornament. It is invisible in the northern and central United States. The variable star, N. Argus, has deeply interested astronomers, because of its great changes in brightness.

ARGO. See ARGONAUTS.

ARGOB, the name of a district in Bashan, referred to in Deut. iii, 4, as the kingdom of Og, and containing threescore walled cities. Its precise location has not been determined. In this connection consult De Vogüé, 'Syrie Centrale (Paris 1869); Porter, 'Five Years in Damascus' (London 1870); 'Giant Cities of Bashan' (ib. 1869) all interesting if not very reliable. Consult also the careful description given in Wetzstein, J. G., 'Reisebericht über Hauran und die Trachonen' (Berlin 1860).

ARGOL (origin of the word unknown), a term applied to the crude acid tartrate (or bitartrate) of potassium, as deposited on the sides of the vats in which wine is fermenting. It exists in the grapes from which the wine is made, but is precipitated from solution in the vats by the alcohol formed during the fermentation. Like many other precipitates, argol brings down more or less of the coloring matter in the solution from which it is deposited, and it is white or red, according to the color of the wine from which it is formed. When purified by re-crystallization from its solution in hot water, argol is known in commerce as "cream of tartar." The purified salt is extensively used in baking powders and to a lesser extent in medicine. It is used in its crude state in metallurgy as a reducing agent in fire assaying.

ARGOLIS, a peninsular state of ancient Greece; between the bays of Nauplia and Ægina, now forming with Corinth, a nome or department. Argolis was the eastern region of Peloponnesus, and its inhabitants were often called Argives. According to the monuments of Greek mythology, Argolis was peculiarly rich, and early cultivated. Here reigned Pelops, an emigrant from Asia Minor, from whom the peninsula derives its name. It was afterward the seat of government of Atreus and Agamemnon, Adrastus, Eurystheus and Diomedes. In the earliest times it was divided into the small kingdoms of Argos, Mycenæ, Tiryns, Trœzene, Hermione and Epidaurus, which afterward formed free states. The chief city, Argos, has retained its name since 1800 B.C. Its inhabitants were renowned for their love of the fine arts, particularly of music. Some vestiges remain of its ancient splendor, and it has at present about 9,000 inhabitants. Near it is the modern capital of Argolis, Nauplia or Napoli di Romania, with an excellent harbor, and the most important fortress of the peninsula. Pop. of the nome of Argolis and Corinth (1907) 153,172.

ARGON (Greek, "inactive," in allusion to its entire lack of chemical affinity), a gaseous substance, presumably an element, discovered in the earth's atmosphere in 1894 by Lord Rayleigh and Prof. William Ramsay. For some years previous to this discovery, Lord Rayleigh had been engaged in a careful determination of the densities of certain gases, and consistent results had been obtained for all of them save nitrogen. This gas, when prepared from air by the abstraction of all other known components, was found to be heavier, by about one part in 200, than the nitrogen prepared from ammonia. There could be no doubt about the reality of the difference, because the same experimental methods, when applied to other gases, gave results that were consistent with one another to about one part in 10,000. In studying the cause of the discrepancy, Lord Rayleigh prepared nitrogen from ammonium nitrite, from urea, and from nitric and nitrous oxides; and found that all specimens of the gas that were prepared from nitrogen compound agree with one another in density, but that the specimens of nitrogen that he prepared from air were uniformly and consistently heavier, by the same constant amount of one part in 200. Provisionally, therefore, he recognized two kinds of nitrogen, which he called "chemical nitrogen" and "atmospheric nitrogen," respectively, to indicate the sources whence they were obtained. He then published a letter in *Nature,* narrating these facts, and calling for suggestions from chemists as to the cause of the systematic difference in density. No ideas of value were elicited. The possibility that "chemical" nitrogen might be contaminated with hydrogen, and that the experimental methods failed to eliminate the last traces of this very light gas, was tested by adding hydrogen to "atmospheric" nitrogen, and then submitting the mixture to the same process employed for

removing any hydrogen that might have existed in the "chemical" nitrogen. If the hydrogen theory of the discrepancy had been true, it would have been found that "atmospheric" nitrogen, when treated in this way, would ultimately agree in density with "chemical" nitrogen; but the test showed that "atmospheric" nitrogen, after the addition and subsequent removal of hydrogen, returned to its original state of higher density, thus proving the adequacy of the experimental methods, and disproving the hypothesis that the difference in density was due to hydrogen. The suggestion was also made that the "atmospheric" nitrogen had partly polymerized into an allotropic state analogous to ozone, or that the "chemical" nitrogen had partially dissociated into monatomic molecules. These possibilities were tested by subjecting both kinds of nitrogen to the action of the silent electric discharge, in an apparatus designed for the production of ozone from oxygen. It would certainly be expected that the difference in density would partially or wholly disappear under this treatment if there were any basis to the polymerization or dissociation hypotheses; but it was found that both kinds of nitrogen retained their initial densities, so that the original difference persisted undiminished in amount. Furthermore, if the lightness of "chemical" nitrogen were due to a partial dissociation induced by the method of preparation, it would be reasonable to expect that the molecules would recombine in time with a resulting return of the density to that observed in "atmospheric" nitrogen. Specimens of "chemical" nitrogen that were allowed to stand for eight months, however, were found to retain their characteristic lightness. At this stage in the investigation, Professor Ramsay asked permission to cooperate in the investigation, and his services were gladly accepted. The hypothesis was made that "chemical" nitrogen contains an unknown gas, *lighter* than true nitrogen; or that "atmospheric" nitrogen contains some similar gas that is *heavier* than true nitrogen. In spite of the many analyses that had been made of the air, it was thought more probable that the unknown gas would be found in "atmospheric" than in "chemical" nitrogen; and hence the experimenters turned their attention to the problem of removing "true" nitrogen from the "atmospheric" nitrogen, with the idea of obtaining a possible residuum, which would at least contain the unknown gas in concentrated form. For this purpose it was proposed to take advantage of the known fact that at a red heat nitrogen will combine with metallic magnesium, with the formation of magnesium nitride. "Atmospheric" nitrogen, carefully freed from all known impurities, was therefore passed through a long tube of hard glass filled with magnesium shavings and heated in a furnace. The first experiment of this sort was made in May 1894, and gave encouraging results, the "atmospheric" nitrogen showing a slight but unmistakable increase in density. A more elaborate experiment of the same sort followed, in which "atmospheric" nitrogen was caused to pass over hot magnesium for more than two weeks. By this means its density, originally about 14 (that of hydrogen being 1), was increased to 19.09, and the bulk of the gas under examination was diminished until not much more than 1 per cent of it remained. Plainly a great concentration of the unknown gas had been effected. To remove the last traces of true nitrogen, pure oxygen was next added, and the mixture exposed to a rain of electric sparks in the presence of caustic soda. When so treated the experimental gas contracted, indicating that the nitrogen was being withdrawn in the form of nitrate of sodium. When contraction was no longer noted, the nitrate of sodium and the excess of oxygen were removed, and it was found that the remaining gas had a density about 20 times as great as that of hydrogen. When subjected to the electric spark and examined by the spectroscope, this residual gas was found to exhibit certain characteristic groups of red and green lines that did not correspond to any element previously known. The experimenters, therefore, felt reasonably sure that a new element had been discovered, and this conclusion has been borne out by all subsequent investigations. The discovery of this element (to which the name "argon" and the chemical symbol "A" have been assigned), was formally announced to the public in August 1895, and for it Lord Rayleigh and Professor Ramsay were awarded the Hodgkins prize and also the grand prize of the Smithsonian Institution. See AIR.

As it was found that air contains 0.933 of 1 per cent (by volume) of argon, it is natural to ask why the new element had escaped detection in the vast number of air-analyses that have been made in the past. The answer is that argon shows no chemical affinity whatever, and as nitrogen is also inert in comparison with most elements, the two were very easily confused. Chemists have almost invariably estimated the nitrogen of the air "by difference"; that is, by removing all such constituents as oxygen, carbon dioxid and ammonia, and taking it for granted that the inert remainder is nitrogen. It might be thought that the spectroscope would betray the presence of argon, when the spectra of "atmospheric" and "chemical" nitrogen were compared; but the curious fact has been established that when argon and nitrogen are mixed, the argon does not reveal itself to the spectroscope unless the mixture contains at least 37 per cent of argon. Upon looking over the work that had been previously done upon air, it was found that Cavendish had isolated nearly pure argon as long ago as 1785, but without recognizing its real nature. Thus, knowing that air contains a considerable quantity of nitrogen, he raised the question whether all of the apparently nitrogenous part of the air "could be reduced to nitrous acid, or whether there was not a part of a different nature from the rest which would refuse to undergo that change." To decide this point he added excess of oxygen to air and passed electric sparks through the mixture (precisely as Rayleigh and Ramsay did) until no further diminution of volume occurred. He then removed the excess of oxygen, together with the oxids of nitrogen that had been formed, and found that only a small bubble remained unabsorbed, which, he says, was not more than one one-hundred and twentieth of the bulk of the original nitrogen. The bubble that he thus obtained and whose nature he did not further question must have been nearly pure argon.

Argon having been discovered, chemists at once undertook to ascertain its chemical properties, but here they met with an obstacle that has not yet been overcome, and which constitutes one of the strangest facts known to chemistry. It was found, namely, that argon cannot be made to enter into chemical combination with any substance whatsoever. Thus Rayleigh and Ramsay have stated that "argon does not combine with oxygen in presence of alkali under the influence of the electric discharge, nor with hydrogen in presence of acid or alkali, nor when sparked, nor with phosphorus at a bright red heat, nor with sulphur. Tellurium may be distilled in it and also sodium and potassium. Red hot sodium peroxid has no effect. Persulphids of sodium and calcium have no effect at a red heat. Platinum sponge does not absorb it. Aqua regia, bromine water, bromine and alkali, and potassium permanganate are all without influence. Mixtures of metallic sodium and silica, or of sodium and boric acid, are likewise without influence, and hence also nascent silicon and boron." Moissan further found that fluorin does not act upon it at any temperature. In short, it may be said that every reagent that the previous experience of chemists indicated as likely to combine with argon has been tried without success, and hence the chemical properties of the element (if, indeed, it has any such properties), are as yet quite unknown. Several announcements of the existence of compounds of argon have been made, but no really convincing evidence of such combination has been given. For example, Berthollet subjected a mixture of argon and benzene to the action of the silent electric discharge for a long time, and observed a diminution in the volume of the argon, which he attributed to its combination with the benzene. Benzene when treated in this way forms a resinous mass, which coats the walls of the tube, and it is not improbable that the small quantity of argon which disappears is held mechanically by the gummy deposit, either in solution or by absorption. At all events the original quantity of argon is restored, unchanged, by heating the resin. It cannot be positively affirmed that no compound of argon exists, but there is no previously known element (not even the metals of the platinum group) that could withstand the action of the substances whose activity has been exerted without effect upon argon. Until some compound can be formed we shall therefore have to infer the atomic weight of argon from determinations of the density of the gas, taken in connection with Avogadro's law. The best determinations made up to the present time indicate that the density of argon is 19.942 times that of hydrogen. If the molecules of argon are diatomic, then 19.94 is the atomic weight of the element, but if they are monatomic, we must double this estimate and conclude that the atomic weight is 39.88 (see ATOMIC THEORY; also GASES, KINETIC THEORY OF). To settle this doubtful point experiments were made to find the ratio of the two specific heats of the gas, and it was found that the specific heat of argon at constant pressure is about 1.644 times as great as the specific heat at constant volume. This indicates that the molecule of the gas contains but one atom, and hence it is necessary to conclude that the atomic weight of argon is 39.88, the atomic weight of hydrogen being taken as 1. Argon has been liquefied and solidified. Its critical temperature is 179.3° F. below zero, and its critical pressure is about 52.9 atmospheres. Liquid argon boils (under ordinary atmospheric pressure) at about 303° F. below zero, and at about 309.3° below zero it freezes. The density of liquid argon is about 1.4046 at its boiling point. Four other elements, associated with argon in the air and closely resembling it in properties, have been discovered as the result of researches suggested by the discovery of argon. They are called, respectively, helium, neon, krypton and xenon (qq.v.). Hundreds of papers dealing with argon and the other gases just mentioned have appeared in the scientific periodicals, so that no bibliography of the subject can be attempted here. Ramsay's book, 'The Gases of the Atmosphere' (1896) gives an excellent account of the chemistry of the air, from the earliest times down to 1896. It must be remembered, however, that our knowledge of argon and its allies is growing rapidly, so that some of the statements that Ramsay makes can be no longer admitted to be true. For example, he states that helium (which had already been discovered when his book was written) does not occur in the air, but it has since been shown that it *is* a component of the air, forming from one to two one-millionths of its bulk. (See GASES, COMPRESSED). Travers' 'The Experimental Study of Gases' may also be consulted with advantage.

A. D. RISTEEN.

ARGONAUT, the appellation of an eight-armed oceanic cephalopod, closely allied to the octopus, and having the same power of swimming backward by forcing water through its funnel. Though called "paper nautilus" it is entirely different from the true nautilus (q.v.), and although, since the earliest days, it has been said to sail upon the surface of the ocean, in its shell as a boat, with two web-like arms spread for sails, this belief is pure fable. Argonauts remain in deep water except in spawning season, and then come to the surface only at night. The male is a naked octopod, and the "boat" of the female has no organic connection with her body, but is a mere receptacle for holding eggs, retained in place by the two dorsal arms, which are membranous and secrete it from their inner surfaces. It is not chambered like that of the true nautilus, but has a radially fluted, semi-transparent spiral shell, enveloping the body as far as the base of the tentacles, increasing in size with the growth of the animal, and attaining a length of six inches. The male is only about an inch in length; one of its very short arms is specialized into an organ of generation, called a "hectocotyle," which detaches itself from the male body, and, having independent locomotory powers, attaches itself to the female, and in some manner unknown fertilizes the eggs. Only a single species is known (*A. hians*), representing the family *Argonautidæ*. See NAUTILUS: OCTOPUS.

ARGONAUTS, the name given in Greek legends to the sailors, who, in a ship called the Argo, made a hazardous voyage to Colchis under the leadership of Jason, in quest of the golden fleece. Jason's uncle Pelias had usurped

the kingdom of Iolcos and would resign it only on condition that Jason should first bring from Colchis the golden fleece suspended in a consecrated grove at Colchis. Among Jason's companions were Hercules, Castor and Pollux, Peleus, Admetus, Meleager, Orpheus, Telamon, Theseus, and his friend Pirithous, Hylas and Lynceus. Having sailed from the promontory of Magnesia, in Thessaly, they reached the harbor of Lemnos, where they remained two years. The women of Lemnos, instigated by the offended Aphrodite (Venus), had slain all the males among them, except Thoas, and they detained among them the welcome strangers. At length they proceeded to the Troad, where Hylas and Hercules were left behind. After various adventures they approached the dreaded Symplegades, rocks which closed together and dashed in pieces vessels passing through them. According to instructions previously received, they caused a dove to fly through before them, and followed, rowing with all their strength, while Orpheus played on his lyre. The rocks stood firm, and the danger was escaped. The last adventure awaited them at the Island of Aretias. Here they found the Stymphalides, birds which shot their feathers like arrows, and from which the heroes could only protect themselves by a violent clashing of weapons. On their arrival at Colchis King Æetes did not refuse absolutely to deliver the golden fleece, but charged Jason with three dangerous labors, thus hoping to destroy him. Jason was to yoke the two fire-breathing bulls of Hephæstus to a ploughshare of adamant, and to plough with them four acres of land consecrated to Ares (Mars), and never before turned up. He was then to sow in the furrows the remaining serpents' teeth of Cadmus, in the possession of Æetes, and to kill the armed heroes which they produced; at last, to fight with and slay the dragon that guarded the golden fleece. All three labors he was to accomplish in a single day. With the help of Medea, the daughter of Æetes, these tasks were accomplished and the fleece obtained. Jason then fled with Medea, but the fugitives were pursued and on the point of being overtaken when Medea averted the danger by killing her brother Absyrtus, and strewing on the road his mangled limbs. The unhappy father quitted the pursuit to collect the bloody limbs of his son and the fugitives escaped. The return of the Argonauts is variously told, but after many perils they reached Iolcos and gave the fleece to Pelias. Whatever the origin of the story, it was certainly developed under the influence of the great period of Greek colonization in the 8th and 7th centuries B.C., when the adventures of the navigators and explorers of the western Mediterranean and the Black sea were told of gods and heroes. The story is scattered through nearly all the literature of Greece. Apollonius of Rhodes first gathered the mass of material into a connected consistent narrative.

ARGONAUTS OF '49, a literary name (the colloquial one being "Forty-niners") applied to the California pioneers. The first discovery of gold was in January 1848, but it was not generally realized till April; from thence till the following winter California itself (recently obtained by the United States from Mexico) was partially depopulated outside the mining camps, even soldiers and sailors deserting in great numbers and rushing to the mines, while executive authority was paralyzed. These local changes of place, however, did not constitute a "voyage for the Golden Fleece" from far distant regions, which is what the term implies. The excitement, spread by official reports, and intensified by journalistic inventions, had fully roused the east by winter; from January onward the great sea routes were thronged. By the end of the year the new province (it never was organized as a Territory, entering the Union as a State from a condition of legal nullity or permitted trespass) contained toward 100,000 people. The imperfect State census of 1852 showed 264,435, nearly all Argonauts proper.

Much the greater portion came by sea; the favored route being by the Isthmus of Panama. The passengers landed at Chagres, took boat up that river to Cruces, then crossed over by horse or mule conveyance to Panama, where they took such coasting steamers or sailing craft as came along. The crowds which flocked thither by all sorts of Atlantic vessels far outran the Pacific fleet's capacity, and large numbers had to wait many weary weeks for a passage. At one time 3,000 were collected at Panama, so wild with impatience that several small companies unsuccessfully attempted to make the voyage to San Francisco in the natives' log canoes. An assemblage of several hundred to a thousand was common; and at one time they enlivened the tedium by issuing a newspaper. But a far more terrible foe than ennui had to be faced: the cholera and Panama fever, which carried off great numbers of the emigrants and a quarter of the inhabitants of Panama. Before the excitement had begun, two new steamers, the *California* and *Oregon*, were assigned to this route to run monthly. The fare was $300, and the competition for space was so great that double price was sometimes paid. The *California* reached San Francisco on her first trip 28 Feb. 1849. When she came up the west coast after rounding the Horn to reach Panama, the gold fever had just reached Peru, and 75 Peruvians took passage. This preoccupation of space so enraged the 1,000 or so of waiting Americans that they induced the commandant of the United States forces in California, who was waiting with them, to issue a proclamation ejecting the Peruvians as intending trespassers on United States public lands not yet opened for settlement. As they refused to go, however, no one dared use force. In one case some 300 intending passengers drew lots for the 52 steamer tickets on sale. Many gold-seekers crossed at Nicaragua, at the Isthmus of Tehuantepec, or at central Mexico. Many thousands, however, chose the cheaper and unbroken but time-wasting sailing voyage of several months around Cape Horn. The vessels on this route were miscellaneous and often unfit and ill manned; the food was poor and insufficient, and the voyage full of hardship. There was also a large overland emigration across the plains, through the Great Basin and its alkali deserts, and over the Coast Range. This journey, too, was full of suffering from lack of food, lack of water, lost trails, and exhaustion; and sometimes after a summer of endurance to the last gasp, the pilgrims saw the snows

close up the mountain passes before them, and either wintered or died on the eastern flank, or lost themselves trying to penetrate through the snow. This overland body had two strongly distinguishing marks from the immigrants by sea. First, it contained nearly all the families among the Argonauts, as distinguished from the solitary masculine adventurers; and therefore nearly all the women. Second, it was nearly all a Northern and free-labor element — an important point in the struggle to make new States free or slave then going on between the sections.

The characteristics of the Argonauts as a body were these: First, they were mostly men, with a few low-caste women, and their moral sense was not therefore quickened by the presence and needs of family life; though families and reputable women were by no means so utterly absent as the exaggerated myths of the old-timers would make it appear. Second, few intended to remain longer than was needed to acquire a fortune and return East. This did not make their settlement in the least less enduring or desirable, but with the paucity of family life, it prevented them for some time from feeling a proper responsibility for public order and the creation of solid institutions, and spasms of illegal violence were expected to do the work of steady legality. Third, they were from all sections of the country, at a time when North and South were daily becoming hostile races. Though the free-State people were largely in the ascendant, the Southerners were the political leaders and the State was steadily Democratic. Yet the former class had no idea of letting sectional politics rule their general action; home issues were too pressing and national ones too academic; and while California as a free State sympathized with and furnished splendid help to the Union, her politics have never been affected by the issues either of slavery or of reconstruction. Fourth, along with men of character and ability, since prominent as business and professional men, State officials, editors, etc., there were of course great numbers of blacklegs, desperadoes, and refugees from justice. These not only defied all law in their relations with each other, but frequently outraged, plundered and murdered the native Spanish inhabitants, and required an amount of time and effort to keep them in order, which the decent element — who were in a great majority — were unwilling to give. Hence society again and again seemed on the verge of being dominated wholly by its criminal classes, and the fear of an occasional uprising of the orderly element did not countervail its being only occasional and the chance of escaping it (see VIGILANCE COMMITTEES). But the best praise which can be given to the essential soundness of the Argonauts is that in a remarkably short time they rose to the same sense of their responsibilities as older commonwealths, and the California of 1860 was not inferior to any of its companions. Consult Audubon, 'Western Journal' (Cleveland 1906); Bret Harte, 'Tales of the Argonauts' (Boston 1875); Royce, 'History of California' (1891); Bancroft, H. H., 'History of California' (4 vols., San Francisco 1884–90); id., 'California inter Pocula' (San Francisco 1888); Shinn, 'Mining Camps' (1885); Taylor, Bayard, 'Eldorado' (New York 1862); Burnett, 'Reminiscences of an Old Pioneer' (1880); McIlhany, 'Recollections of a Forty-Niner' (Kansas City 1908); Stillman, 'Seeking the Golden Fleece' (San Francisco 1877).

ARGONNE, ăr'gŭn', France, a hilly rock and forest covered district of the northeastern region, on the borders of Lorraine and Champagne, now contained in the departments of Marne, Meuse and Ardennes. The forest of Argonne over 30 miles long and from one to 8 miles wide, is celebrated for the Campaign of Dumouriez against the Prussians in 1792, and was also the scene of several events in the Franco-Prussian War, 1871–72, and in the great European War, 1914–17.

ARGOS, an important city of ancient Greece. The conquest of Argos by the Dorians forms the first really authenticated event in its history. Argos was now a Doric city, though it retained with part of its Achæan population some of its ancient habits, particularly the worship of Hera (Juno). It had also a temple of peculiar sacredness to Apollo. It was long the first Dorian city in Greece, Sparta being the second, and Messene the third. From the time of the ascendency of Sparta, Argos was divided between a democratic and an oligarchic party, the former of which inclined to the Athenian, the latter to the Spartan alliance; but the general spirit of the city tended toward enmity to Sparta. In 362 Argos fought with Thebes against Sparta and Athens. The celebrated Pyrrhus was killed in an invasion of Argos in 272. In 229 Argos joined the Achaian League, to which it continued to adhere till its overthrow by the Romans. The town of Argos is a straggling modern place, with houses mostly surrounded by gardens, and few buildings of importance. The chief relic of the ancient city is the theatre. There is an acropolis, 1,000 feet high, crowned by a ruined castle. Pop. about 9,000.

ARGOS, Ind., town of Marshall County, eight miles south of Plymouth, the county-seat, on the Dixie Highway and on the New York, Chicago and Saint Louis and the Lake Erie and Western railroads. It contains a saw mill, bending factory, printing establishment, two grain elevators and three banks with combined resources of $200,000. It is the headquarters of the National Retail Hardware Association. The value of its taxable property is estimated at $525,745. It has a high school. Pop. 1,200.

ARGOSTOLI, ăr'gŏs-tō'lę, an important city of the Ionian Islands, the capital of Cephalonia. Its harbor is considered the best in the Ionian Islands, and there are excellent quays. The town is the residence of a Greek bishop. Wine, oil, melons and currants are exported. Several mills here are driven by a current of sea water flowing through an artificial channel and then disappearing through fissures in the rocks. A naval school has been established here. Pop. about 14,000.

ARGOSY (a corruption, by transposition of letters, of the name of the seaport Ragusa), the term originally for a carrack or merchant ship from Ragusa and other Adriatic ports, now used poetically of any vessel carrying rich merchandise. In English writings of the 16th century the seaport named is variously written

Ragusa, Aragouse or Aragosa, and ships coming thence were named Ragusyes, Arguzes and Argosies; the last form surviving and passing into literature. The incorrect derivation from Jason's ship, the *Argo*, is of modern origin.

ARGOUT, är'gōō', **Antoine Maurice Apollinaire, Count d'**, a French statesman and financier: b. Isère 1782; d. 1858. In 1810 he was auditor to the Council of State, was made prefect of Gard in 1817 and peer of France in 1819. In July 1830 he acted as mediator between Charles X and the popular leaders. He obtained several concessions from the former, but these came too late. In the same year Argout became Minister of Marine and in 1833 Minister of the Interior. He was governor of the Bank of France, after 1834, except for a time in 1836 when he was Minister of Finance.

ARGUELLES, är-gwā'lyās, **Agustín**, Spanish statesman: b. Rivadisella, Asturias, 1776; d. Madrid, 23 March 1844. On the outbreak of the war of independence in 1808 he attached himself to the patriotic party, and, as representative of his native province in the Cortes, gained a high reputation for eloquence (1812–14). On the restoration of Ferdinand VII, Arguelles was arrested, and suffered several years' imprisonment in the galleys till the revolution of 1820 restored him to freedom. He became Minister of the Interior, but soon resigned, being displeased with the narrow bigotry of the court. On the fall of the Constitution (1823) he fled to England, where he remained till the amnesty of 1832. On his return to Spain, being nominated to the Cortes, he was repeatedly made president and vice-president of the Chamber of Deputies, and always showed himself a moderate but unwavering reformer. In 1841 he opposed all concordats with the Pope. He was guardian of the young Queen Isabella during the regency of Espartero. To the last he displayed those remarkable oratorical gifts which in his youth earned for him the sobriquet of "Spanish Cicero." Consult Evaristo San Miguel, 'Vida de D. A. Argüelles' (Madrid 1851).

ARGUMENT, a term sometimes employed as synonymous with the subject of a discourse, but more frequently appropriated to any kind of method employed for the purpose of confuting or at least silencing an opponent. Logicians have reduced arguments to several distinct heads, of which the only one that can be said to have truth only for its object is the *argumentum ad judicium*, founded on proof and addressed to the judgment. See ARGUMENTATION; LOGIC.

ARGUMENTATION is the process of proving or attempting to prove a given proposition the truth of which is doubtful or disputed. It is, in many respects, the converse of the process of inference which is reasoning from premises to a conclusion. In arguing, the conclusion becomes a thesis and the facts or premises from which it was inferred become the reasons by which it is proved. Inference is a forward movement from the premises to the conclusion; arguing is a backward movement, or reference, from the thesis to the grounds which support it. Inference is the process by which we ourselves reach a conclusion or belief; arguing is the process by which we seek to induce belief in others.

Proof requires that the proposition to be proved be brought within the scope of an accepted law or principle, a law or principle being defined as every general proposition that includes, or may be applied to, unascertained cases. This may be done by setting forth evidence, that is, facts observed by those sought to be convinced, or established to their satisfaction, which show the relation between the two. In practice argumentation is usually elliptical. The whole of the proof is seldom stated in full. The advocate is usually content to state one or more facts, leaving it to those addressed to supply the presuppositions in the light of which alone such facts may be interpreted. Implications which may be readily supplied are usually omitted. Thus, if it be argued that "Congress is in session" for the reason that "the flag is flying over the Capitol," it is clear that the assertor relies not only on the fact given as a reason but also on an implied assumption which may be expressed as a general proposition: "Whenever the flag is flying over the Capitol, Congress is in session." Every valid argument, then, when fully expressed, consists of a proposition to be proved which may be called the Thesis, and two proving propositions usually called the reasons or the proof, one of which is a general proposition and may be called the Principle, and the other is a statement of evidence and may be called for distinction the Reason, and shows that the thesis is brought within the scope of the principle. A thesis is said to be proved: (1) if the reason and the principle are known or admitted to be true, and (2) if the thesis is contained, involved or implied in them. An argument may be compared to a lever; the thesis is the weight to be lifted, the principle is the fulcrum and the reason, the power. The first requirement of proof has reference to those sought to be convinced. The advocate must found his thesis on something which they recognize to be true. If the reason or principle be not accepted, the proof remains incomplete until the disputed proposition is itself proved by reference to another reason and principle, and so on until some holding ground is reached, some reason and principle which will be unchallenged. The second requirement is concerned with the relation of the thesis to the other propositions of the argument. If the principle and the reason are both expressed, the question whether or not they imply the thesis is manifest in most cases on simple inspection.

Proof may be either conclusive or probable. To prove a proposition means strictly to establish its truth conclusively and beyond all doubt. In practice, however, a proposition is said to be proved when its truth is shown to be probable or highly probable, or so probable that we do not hesitate to act as if it were true. Thus, in a criminal trial a prisoner's guilt is said to be proved if it be established beyond a reasonable doubt; and in a civil trial the plaintiff's case is said to be proved if there is a mere preponderance of evidence in its favor. There are many principles that cannot be asserted or accepted as true universally, but only generally, or in most cases, and when such a principle is relied on as the foundation of an argument the thesis can only be asserted as probably true. So if the reason can only be asserted as probable, the thesis can have no higher certainty. In most

cases it is only possible to establish a disputed question with more or less probability, to afford a presumption of its truth, and to shift the burden of proof on him who maintains the contrary.

Proof is said to be direct when the reasons directly imply the thesis, and indirect when they imply the falsity of all possible alternatives, and hence indirectly imply the truth of the thesis. Thus, if we argue that a given straight line, AB, is equal to another given straight line, CD, we employ the indirect mode of proof if we show that AB is not greater than CD, and that it is not less. The only possible alternative is that AB is equal to CD.

Argumentation includes also the processes of disproof and of refutation which, however, are fundamentally processes of proof, since disproof consists in proving that a given thesis is false, and refutation consists in proving that a thesis for which reasons have been given is not proved by them, having regard to the requirements of proof.

Principles may be divided according to their source into two general classes, namely, those derived from Experience and those derived from Authority. Principles derived from Experience include the laws of nature, scientific truths and, in short, all general propositions which are suggested or confirmed by experience, as for example, "all men are mortal"; the air has weight"; "unsupported bodies fall to the ground"; "division of labor increases its efficiency."

Principles derived from Authority include civil laws, rules of action and other general propositions, declared, enacted or promulgated, usually for the guidance or government of a class or community, by a legislature, church, judge, lawgiver, teacher, inspired writers or by any man or body of men having or assuming authority, as for example: "every person who, being a witness in a judicial proceeding, makes a statement under oath which he knows to be false is guilty of perjury and is liable to a penalty"; "it is wrong to commit murder"; "all men are created free and equal"; "all who believe will be saved."

Arguments may be divided into two general classes, according as the principle on which they are based is derived from Authority or from Experience. This division is similar to that adopted by lawyers when they speak of issues of law and issues of fact. The following is an example of an argument where the principle is an enacted law:

Thesis: This prisoner is guilty of perjury and is liable to a penalty.

Reason: Because being a witness in a judicial proceeding he made a statement under oath which he knew to be false.

Principle: Because every person who, being a witness in a judicial proceeding, makes a statement under oath which he knows to be false, is guilty of perjury and is liable to penalty.

Arguments based on principles derived from Experience may be conveniently divided into eight general classes, namely: arguments to prove facts of Causation, arguments from Example, from Analogy, from Cause to Effect, from Effect to Cause, from Testimony, from Sign and from Circumstantial Evidence.

Facts of Causation.— That one thing is the cause or the effect of another may be proved by reference to one of the five principles first formulated by John Stuart Mill, which are as follows:

(a) *Agreement.*—When two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree is the cause (or effect) of the given phenomenon.

(b) *Difference.*— If an instance in which the phenomenon under investigation occurs and an instance in which it does not occur have every circumstance in common save one, that one occurring only in the former, the circumstance in which alone the two instances differ is the effect or the cause or an indispensable part of the cause of the phenomenon.

(c) *Joint Method.*— If two or more instances in which the phenomenon occurs have only one circumstance in common, while two or more instances in which it does not occur have nothing in common save the absence of that circumstance, the circumstance in which alone the two sets of instances differ is the effect or the cause or an indispensable part of the cause of the phenomenon.

(d) *Residues.*— Subduct from any phenomenon such part as previous induction has shown to be the effect of certain antecedents and the residue of the phenomenon is the effect of the remaining antecedents.

(e) *Concomitant Variations.*—Whatever phenomenon varies in any manner whenever another phenomenon varies in some particular manner is either a cause or an effect of that phenomenon or is connected with it through some fact of causation.

These five principles may be reduced to two, which are: negatively, that none of the antecedents of an effect that can be dispensed with without preventing the effect is the cause, and positively, that every antecedent of an effect that cannot be dispensed with without preventing the effect is the cause or part of the cause. These principles may be proved by reference to two principles which are the ultimate foundation of all arguments from Experience. These are the law of Universal Causation which may be expressed by saying that "Every event has a cause," and the law of the Uniformity of Causes which may be expressed by saying that "Like causes produce like effects in like circumstances."

It is in accordance with these principles that investigations are carried on in every branch of science that has to do with tracing the relation of cause and effect, and establishing principles based thereon.

Example.— We use the argument from Example when we cite as a reason for the truth of a general proposition a number of observed or known facts similar to those summed up in the thesis, the facts set forth being examples of the general truth they are cited to prove. Thus, we argue that all horned animals are ruminant because the ox, the sheep, the deer and other horned animals are ruminant. In an argument of this kind the reason is seldom stated in full and the principle is seldom stated at all. When the proposition to be proved is universal, the advocate relies on the implied assumptions that no negative example has been found and that the search has

been exhaustive. He is usually content to state one or more positive instances and shift on his opponent the burden of showing an exception, or that the search has not been complete. The argument may be stated in full as follows: Thesis: All horned animals are ruminant; Reason: Because A, B, C and a number of other horned animals are ruminant and no horned animal has been found, after due search, that is not ruminant; Principle: Whatever has been found to be true in a number of instances of a phenomenon and never found to be false, after due search, in any, is true of all.

In like manner we may argue that all men are mortal, that unsupported bodies fall to the ground, that food is necessary to animal life, that the price of protected manufactures tends to decline.

Analogy.— In an argument from Analogy points of resemblance between two things are relied on to prove that the resemblance extends further than is actually known or observed. Thus, when we argue that a given specimen of handwriting was written by a particular person because it resembles handwriting that is known to have been written by that person, we employ an argument from Analogy. The principle upon which this argument is based may be stated as follows: "Whatever is true of a thing is true of what essentially resembles it." It is sometimes said that no thesis can be proved conclusively by analogical evidence, but if essential resemblance can be shown, if, in other words, the analogy is complete, the argument may be as conclusive as any other. In many cases in which the argument from analogy is employed it is impossible to show essential resemblance, and, of course, the thesis cannot be asserted as more than probably true. Thus, in the argument that Mars is inhabited because of its many points of resemblance to the earth it is impossible to say that the thesis is even probably true, since there are so many points of essential difference and so many essential points as to which it is unknown whether Mars resembles the earth or not. To justify a probable conclusion there must be more points of resemblance than of difference and the points as to which we do not know whether the two things compared agree or differ should be considered as points of difference. Moreover, of all possible points of resemblance and of difference only those should be considered which are essential, that is to say, which have a direct bearing on the question to be proved. The principle upon which we rely in using a probable argument from analogy may be stated as follows: "When two things resemble each other in a preponderating number of essential particulars what is true of one is probably true of the other."

The arguments from Example and from Analogy depend in the last analysis upon causation. The uniformity of the facts in the one case and the essential similarity of the facts in the other lead us to infer a cause which, although not known, is assumed to exist to account for the fact or class of facts to be proved.

Cause to Effect.— An argument from Cause to Effect is one in which the existence of a known cause is given as a reason to prove an effect, as when we argue that a man will die because he is afflicted with a particular disease. Such an argument may be only probable since the action of every cause is liable to be frustrated by other agencies, and it approaches to conclusiveness in so far as it can be shown that no other agency is operating or will operate to prevent the effect. When an argument of this kind is employed the assumptions relied on are that the circumstance given as a reason has been found to be adequate to produce the alleged effect, that its action cannot be frustrated and that it will be followed by its effect in this case as in the former case or cases, or in other words, that like causes produce like effects. The argument may be expressed in full as follows: T: A will die; R: Because he is afflicted with X, a cause of death that cannot be frustrated; P: Every cause that cannot be frustrated will be followed by its effect. The argument may be stated more simply by using as a principle the law of the particular effect: T: A will die; R: Because he is afflicted with X; P: Because all who are afflicted with X die. In like manner we may argue from motives to actions which they tend to produce.

Effect to Cause.— An argument from Effect to Cause is one in which the existence of an effect is given as a reason to prove a cause that is known to be adequate to produce that effect. Such an argument may only be probable since the same effect may be produced by two or more causes, and it approaches to conclusiveness in so far as all the causes but one can be shown not to be operative. Thus, when we argue that it has rained because the streets are wet we use an argument from an effect (the wet street) to a cause (rain), and it is conclusive in so far as we show that no other cause operated which might produce the effect, as for example, a heavy dew, melting snow, the sprinkling cart, the bursting of a water main, etc.

The principle relied on in arguments of this kind may be stated as follows: when any circumstance is known to be adequate to produce a given effect, that effect having appeared and no other cause having operated to produce it, the effect in question was preceded by that circumstance.

Testimony.— An argument from Testimony may be regarded as an argument from an effect to a condition, the giving of the testimony being the effect and the reality of the fact testified to being a more or less probable condition of the effect; in other words we argue that the testimony would not have been given if the fact testified to were not true. The assumption relied on in every argument from testimony is that the witness is trustworthy, and the principle on which we rely is: what a trustworthy witness testifies to is true. An argument from testimony may be stated formally thus: T: A assaulted B; R: Because C, a trustworthy witness, testifies that he saw him do it; P: Because what a trustworthy witness testifies to is true. It is assumed both in the courts of justice as well as in the ordinary affairs of life that a witness is trustworthy unless the contrary is shown, in much the same way that an accused person is presumed to be innocent until he is proved to be guilty, and the burden of showing that he is not trustworthy is usually upon him who asserts his untrustworthiness.

Sign.—An argument from Sign is one in which the fact to be proved and the fact cited as a reason, although not related as cause and effect, are associated through some fact of causation, usually as joint effects of a common cause either known or assumed to exist. Thus, when we argue that it will rain because the mercury is falling in the barometer, or that this animal is a ruminant because it is horned, or that Congress is in session because the flag is flying over the Capitol, we use arguments from sign. Arguments from testimony, from cause to effect and from effect to cause, are also sometimes called arguments from sign, but it is convenient to use the term in the sense above indicated. In a wide sense all arguments are arguments from sign since sign is only another name for evidence. The principle relied on in this argument is usually a law already established by the argument from Example.

Circumstantial Evidence.—In this argument the reason consists of a number of facts or circumstances any one of which taken by itself may have little evidential force, but which taken together form a body of evidence that is often stronger than the direct testimony of witnesses. It is in the nature of an argument from cause to effect or from effect to cause or from sign, or it may contain elements of all three. An example of the establishment of a thesis by circumstantial evidence may be taken from almost any criminal trial. In one case the house of a license inspector, who had aroused the hostility of liquor sellers by a strict enforcement of the law, was wrecked by some explosive. Shortly after the explosion, which happened about one o'clock in the morning, marks of footsteps in the fresh snow were found leading from the place of the explosion to one of the hotels, not by the most direct route, but circuitously around a block and through a back alley to the rear entrance of the hotel. In one of the rooms was found a pair of boots which coincided with the footmarks made in the snow, and under the mattress of the bed there were two sticks of dynamite and an unused dynamite fuse. The owner of the boots who occupied that room was unable to give any satisfactory explanation of these facts, and he was tried and convicted of the crime. The reason in an argument of this kind is seldom stated in full. The advocate relies on an implied assumption that the facts stated as evidence cannot be accounted for in any reasonable way except on the truth of the thesis. The proof of incriminating facts has the effect of shifting upon the accused the burden of showing that the facts can be explained or accounted for in some other way. The principle upon which an argument of this kind is based may be stated as follows: "Every thesis that is exclusively sufficient to explain a given set of facts is true," and the whole argument may be stated formally as follows: T: A caused the death of B; R: Because that thesis is exclusively sufficient to explain the facts A, B, C, D, etc.; P: Every thesis that is exclusively sufficient to explain a given set of facts is true. The same kind of argument is employed in a great variety of other cases, as for example in proving the existence of a glacial epoch in prehistoric times, or that Sir Philip Francis wrote the letters of Junius.

Arguments from example, from analogy and to prove facts of causation are usually classed as inductive arguments and all others as deductive. For the distinction between inductive and deductive see the article on LOGIC.

Disproof, like proof, may be direct or indirect. It is direct when the reasons directly imply the falsity of the thesis, and it is indirect when the reasons imply the truth of any one alternative, or of any fact inconsistent with the truth of the thesis. Thus, the thesis in a criminal trial that the prisoner at such a time and place committed a certain offense may be disproved indirectly by the proof that the prisoner at that time was elsewhere, usually called proving an *alibi*. A general proposition may be disproved indirectly in two ways, first, by proving exceptions called exceptive disproof; secondly, by showing that a proposition manifestly absurd is logically deducible from it, called a *reductio ad absurdum*.

Refutation consists in showing the fallacy of an argument having regard to the requirements of proof. This may be done in two ways, first, by showing that the reason or the principle relied on, whether express or implied, is untrue. Thus, an argument from Testimony may be refuted by showing that the witness is untrustworthy, as for example, that he lacked the means or opportunity for accurately observing the facts testified to, that he was biased by interest or hostility, that his testimony is inconsistent with itself or with other facts better known or better established, that his memory is defective, that he is known to be untruthful, etc. An argument from Example may be refuted by showing exceptions to the general law sought to be proved, or by showing that the search for negative examples has not been exhaustive. An argument from Analogy may be refuted by showing points of essential difference between the things compared; an argument from Cause to Effect, by showing the operation of other causes to prevent the effect; and an argument from Effect to Cause, by showing the operation of other causes to produce the same effect. The common fallacy committed in arguments to prove facts of causation is to argue that one thing is the effect of another merely because it follows that other—*post hoc ergo propter hoc*—other antecedents of the effect besides the alleged cause being overlooked. In an argument from circumstantial evidence there is an implied assumption that the facts given as a reason cannot be explained or accounted for in any reasonable way except on the supposition that the thesis is true. The argument may be refuted by showing that the facts may be otherwise explained. The so-called "theory of the defense" in a criminal trial is usually a thesis by which the facts may be accounted for consistently with the prisoner's innocence.

Secondly, an argument may be refuted by showing that the principle and the reason, even if true, do not imply the thesis. Fallacies of this kind all involve some form of irrelevancy. Thus, in the fallacy of "evading the issue," the reasons imply an irrelevant conclusion, or in other words, the conclusion proved is not the question in dispute, but is either (1) a thesis that is like it and is intended to be mistaken for it; or (2) a thesis that is entirely different from the question at issue, the argument being often employed to distract attention from the

real issue, or as it is sometimes expressed, "to draw a herring across the trail." The argument *ad hominem* which is addressed, not to the merits of the case, but to the character, principles or conduct of an opponent; the argument *ad populum* or *ad captandum*, which consists in making an improper appeal to the feelings of those addressed; the argument *ad verecundiam* (reverence) which invokes the authority of a great name as concluding the question; the *tu quoque* argument—are all forms of the fallacy of evading the issue, as opposed to the argument *ad rem*, which is addressed to the matter in dispute. This fallacy is often committed in refutation when our opponent by way of answer elaborately disproves a proposition which we never maintained, a process which is sometimes called "setting a straw man up only to knock him down." In like manner the reason or the principle or both may be irrelevant through ambiguity of language or otherwise.

The fallacy of "begging the question" consists in attempting to prove a thesis by itself which in the course of the argument is either tacitly assumed to be true or, if expressed as a reason, is disguised in an equivalent form of words.

The fallacy of *non sequitur* (it does not follow) really includes all the foregoing fallacies of the second class, but the name is usually restricted to loosely constructed arguments, for which no appropriate name has been found. Professor DeMorgan gives the following example: "Episcopacy is of Scripture origin; the Church of England is the only Episcopal Church in England; therefore, the Church established is the Church that should be supported."

Bibliography.—Bain, 'Logic Deductive and Inductive'; Baynes, 'Analytic of Logical Forms'; Boole, 'Logic'; Bosanquet, 'Essentials of Logic'; Bowen, 'Logic'; Bradley, 'Principles of Logic'; Creighton, 'Introductory Logic'; Day, 'Art of Discourse'; DeMorgan, 'Formal Logic'; Fowler, 'Deductive Logic,' 'Inductive Logic'; Hamilton, 'Lectures on Logic'; Hibben, 'Inductive Logic'; Hill, 'Principles of Rhetoric'; Hyslop, 'Elements of Logic,' 'Logic and Argument'; Jevons, 'Lessons in Logic,' 'Principles of Science'; McCosh, 'Logic'; McGregor, 'System of Logic'; Mill, 'System of Logic'; Minto, 'Logic, Inductive and Deductive'; Sidgwick, 'Argument,' 'Fallacies'; Sigwart, 'Logic'; Spencer, 'Principles of Psychology'; Thomson, 'Outline of the Laws of Thought'; Venn, 'Empirical Logic'; Whateley, Elements of Logic,' 'Elements of Rhetoric'; Wills, 'Circumstantial Evidence.'

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ARGUNOV, är-goo'noff, **Ivan P.**, Russian painter: b. 1727; was a serf of Count Sheremetyev (A. Matvyeyev's relation) and became a pupil of G. H. Grot. The date of his death is not positively known. That event occurred, we think, not in 1797, as sometimes stated, but probably later by a year or more. Despite the researches of S. Dyagilen, he still remains, as A. Benois says in 'The Russian School of Painting' (New York 1916), a somewhat obscure figure; indeed the obscurity or lack of certainty extends to the authorship of some of the paintings usually attributed to him, one reason for such uncertainty being traceable to the circumstance that he did not hesitate to sign portraits copied from other artists' originals—in this respect adopting a practice too common among his contemporaries. Benois observes that such "mixing of copies with original work makes the estimation of his talent a difficult task. Thus it is to be regretted that we cannot be certain of Argunov's authorship in regard to one of the best productions of 18th century Russian painting, the portrait of Countess Barbara Alexeyevna Sheremetyev, which can bear comparison with the portraits of Tocqué, Rotari and Van Loo. Of course all the interest of this characteristic and soundly realistic portrait would be lost if the work proved to be Argunov's copy from the forgotten original by one of these masters." Other meritorious portraits are those of Count P. Sheremetyev, Field Marshal Boris Petrovich Sheremetyev and Countess V. P. Razumovsky. Engravings of the foregoing, with the exception of the last mentioned, were made by P. Antipiev. Almost incomparably inferior are, as a rule, other portraits of the Argunov series; yet even in the poorer work we find, besides the mere charm of the past and of interesting costumes and poses, many fine qualities, not a little purely pictorial merit—fairly good painting and sufficiently correct design. We mention finally, as by him, the 'Cleopatra' (1750) in the Roumientsef Museum at Moscow; on the Sheremetyev estate portraits of Prince Michael Golitzin (engraved by A. Radigues) and of Prince A. M. Tscherkaski; on the Ostankina estate a full-length portrait of Czar Paul I. Still other portraits attributed to him are in the Trétiakof or Tretyakov Museum at Moscow.

ARGUS, (1) a personage represented in Greek mythology as having 100 eyes, or as having his whole body covered with eyes, half of these being always awake while the rest were closed in sleep. The jealous Hera made him keeper of the unhappy Io; but Hermes lulled him to sleep with the sound of his flute and cut off his head. Hera afterward took his eyes to adorn the tail of the peacock. (2) The son of Zeus and Niobe and mythical ancestor of the Argives, and founder of Argos. (3) The builder of the ship *Argo*. See ARGONAUTS. (4) Argus, the dog of Odysseus, who recognized his master after 20 years' absence, and died of joy. (5) In Homer, the kingdom of Agamemnon, the Peloponnesus and even all Greece. Also the name of several Greek cities and towns of which Argos, capital of Argolis, was the most renowned.

ARGUS AND PELICAN, Battle of the. In the War of 1812 Capt. William H. Allen (q.v.) in the sloop-of-war *Argus* (rated as a 16 but carrying 18 24's and two long 12's) had wrought great havoc among British merchantmen in the English Channel, in a single month destroying more than 20 ships valued at $2,000,000. Accordingly the British admiralty sent ships in pursuit, one of which, the *Pelican* (16 32's, four long 12's and one short 12), Capt. John F. Maples, overtook the American ship on 14 Aug. 1813 in the Irish Channel, off the Welsh coast. At first the *Argus*, having

the advantage of position, raked the *Pelican*, but her guns were so poorly served and so badly aimed that the *Pelican* was almost uninjured. On the other hand, the British gunnery was excellent, and soon the rigging of the *Argus* was in such condition that she became unmanageable, whereupon the *Pelican* for 20 minutes raked her at close range from the starboard quarter without receiving a single shot in return. After 43 minutes of fighting the British prepared to board the *Argus*, but the latter struck her colors, having lost six killed and 17 wounded, while the British loss was only seven killed and wounded. Allen was mortally wounded and died in a hospital at Plymouth, England. As Allen was responsible for the high degree of excellence attained by the gunners of the frigate *United States* (q.v), the poor marksmanship of the *Argus* crew seems inexplicable unless, as some have stated, part of the crew was drunk, a brig from Oporto, laden with wine, having been captured the night before the battle. Consult Cooper, J. F., 'Naval History' (Vol. II, pp. 113–15); Maclay, E. S., 'History of the Navy' (Vol. I, pp. 523–29); Roosevelt, 'Naval War of 1812' (pp. 205–09); Adams, 'United States' (Vol. VII, pp. 303–08); Mahan, A. T., 'War of 1812' (Vol. II, p. 217 et seq.); James, William, 'Naval Actions' (pp. 74–78); Wiley and Rines, 'The United States' (Vol. V, pp. 475–77); Bowen, Abel, 'Naval Monument' (pp. 69–77); Spears, J. R., 'History of Our Navy' (Vol. II, pp. 356–71).

ARGYLE, är-gīl', **Campbells of**, the designation of a distinguished Scottish family. Among its most noted representatives are: ARCHIBALD the 2d Earl, who was killed at the battle of Flodden, 1513. ARCHIBALD, 5th Earl, attached himself to the party of Mary of Guise, and was the means of averting a collision between the reformers and the French troops in 1559. He was commissioner of regency after Mary's abdication, but afterward commanded her troops at the battle of Langside, and died in 1575. ARCHIBALD, 8th Earl and Marquis, b. 1598, was a zealous partisan of the Covenanters, and was created a marquis by Charles I. It was by his persuasion that Charles II visited Scotland and was crowned at Scone in 1651. At the restoration he was committed to the Tower, and afterward sent to Scotland, where he was tried for high treason, and beheaded in 1661. ARCHIBALD, 9th Earl, son of the preceding, served the King with great bravery at the battle of Dunbar and was accordingly excluded from the general pardon by Cromwell in 1654. On the passing of the Test Act in 1681 he refused to take the required oath except with a reservation. For this he was tried and sentenced to death. He, however, escaped to Holland, whence he returned with a view to aiding the Duke of Monmouth. His plan failed, and he was taken and conveyed to Edinburgh, where he was beheaded in 1685. ARCHIBALD, 10th Earl and 1st Duke, son of the preceding, died in 1703. He took an active part in the revolution of 1688–89 which placed William and Mary on the throne, and was rewarded by several important appointments and the title of duke. JOHN, 2d Duke, and Duke of Greenwich, son of the above, was born in 1680 and died in 1743. He served under Marlborough at the battles of Ramilies, Oudenarde and Malplaquet, and assisted at the sieges of Lisle and Ghent. In 1715 he fought an indecisive battle with the Earl of Mar's forces at Sheriffmuir, near Dunblane, and forced the pretender to quit the kingdom. GEORGE JOHN DOUGLAS CAMPBELL, 8th Duke, Baron Sundridge and Hamilton, was born in 1823 and died 24 April 1900. He early took a part in politics, especially in discussions regarding the Presbyterian Church of Scotland. In 1852 he became Lord Privy Seal under Lord Aberdeen, and again under Lord Palmerston, in 1859; Postmaster-General in 1860; Secretary for India from 1868 to 1874; again Lord Privy Seal in 1880, but retired, being unable to agree with his colleagues on their Irish policy. He was the author of 'The Reign of Law' (1866); 'Primeval Man' (1869); 'The Burdens of Belief' (1894); 'Organic Evolution' (1898). SIR JOHN DOUGLASS SUTHERLAND CAMPBELL, 9th Duke of Argyll in the peerage of Scotland and 2d in that of the United Kingdom, hereditary chief of the Clan Campbell, Knight of the Most Noble Order of the Garter, K. T., G. C. M. G.: b. 6 Aug. 1845; d. 2 May 1914. He was probably better known by his former title of Marquis of Lorne. He married, 21 March 1871, Princess Louise, daughter of Queen Victoria; was educated Edinburgh Academy, Eton, Saint Andrew's University and Trinity College, Cambridge. Represented Argyllshire as a Liberal 1868–78. When his father was Secretary of State for India (1868–71) he was his private secretary; he was made a privy councillor in 1875, and was governor-general of Canada 1878–83. In the Home Rule split of 1886 he separated from the Liberal party and contested Central Bradford as a Unionist in 1892. Three years later he was returned for South Manchester and sat in Parliament till 1900, when he succeeded his father in the dukedom. King Edward VII appointed him chancellor of the order of Saint Michael and Saint George; he was hereditary master of the King's household in Scotland, and at the last two English coronations he carried the sceptre and the garter. He was an honorary colonel of the Argyll and Sutherland Highlanders, the London Scottish and several other regiments. The Duke was a many-sided man, intensely Scottish and endowed with high literary talent. He wrote poetry, books on travel, imperial politics and Scottish social history. Among his best-known works are 'A Trip to the Tropics and Home Through America' (1867); 'Guido and Lita' (1875); 'Imperial Federation' (1885); 'Life of Palmerston' (1892); 'The Life and Times of Queen Victoria' (1901); 'Passages from the Past' (1907); and 'Yesterday and Tomorrow in Canada' (1910). As he left no heir the title devolved upon his nephew, Niall Diarmaid Campbell.

ARGYLLSHIRE, är-gīl'shĭr, **Scotland**, a west midland county bordering on the Atlantic Ocean and the Irish Sea. It consists partly of mainland and partly of islands belonging to the Hebrides group. Total area is 3,230 square miles, including area of islets, 616 square miles. The greatest length of mainland is about 115 miles, the greatest width 55 miles. From the windings of the numerous bays and creeks with which the land is everywhere indented it has more than 2,200 miles of sea-coast. The chief towns are the capital, Inverary, Campbeltown,

Oban, Dunoon, Lochgilphead and Tobermory. The chief articles of export are sheep, cattle, horses, fish, slate and granite. One of the most important branches of industry besides sheep-grazing is the fishing of herring, cod and ling. The principal manufactures are whisky and coarse woolens. Argyllshire was anciently ruled by the Macdonalds of the isles and later by the Campbells, whose present representatives, the Duke of Argyll and the Marquis of Breadalbane, are the chief landed proprietors. Among the antiquities of Argyllshire are the celebrated monastery of Iona and the remains of a Cistercian priory in Oronsay. The most noted of its natural curiosities are the basaltic columns and cave of Staffa (q.v.). Pop. 71,000.

ARGY'RIA, or **SILVER POISONING.** See TOXICOLOGY.

ARGYR'ODITE (Greek, "like silver"), a mineral first observed at Freiberg, Saxony, and found upon analysis to contain a previously unknown metallic element, to which the name "germanium" has been given. Argyrodite has the formula $4Ag_2S.GeS_2$, and crystallizes in the isometric system. It has a hardness 2.5 and a specific gravity varying from 6.08 to 6.26. It has a metallic lustre, and fresh fractures show a gray color tinged with red or violet. Its crystals are usually small and it also occurs massive. Large crystals have been found in Bolivia.

ARI THORGILSSON, ä'rę-tôr'gęl-sŏn, the father of Icelandic literature: b. 1067; d. 1148. He was the first Icelander to use his mother tongue as a literary medium. His 'Islendingabók,' a concise history of Iceland from its settlement (about 870) until 1120 is preserved only in an abstract. Later Icelandic writers modeled their style upon his.

ARIA, ä'rę-ą or ä'rĭa (Ital. for "air"), musical term, equivalent to the English "air," signifying a melody apart from the harmony, but especially a musical composition for a single voice or instrument, with an accompaniment of other voices or instruments.

A'RIAD'NE, the daughter of Minos, King of Crete, who, having fallen in love with Theseus when engaged in his attempt to destroy the Minotaur, gave him a clue of thread, which served to guide him out of the labyrinth after having slain the monster. Theseus, on leaving the island, took with him Ariadne, but deserted her on the Isle of Naxos. Dionysus found Ariadne and made her his bride. Ariadne's fortunes have been a favorite subject with artists.

ARIANISM is the name given to the doctrine of the person of Christ advocated by Arius and his followers. It contained nothing essentially new, but it crystallized certain modes and tendencies of thought which had been more or less prevalent in the Church for three or four generations. (See CHRISTOLOGY). The views of Arius and the strict Arian party may be summarized as follows: (1) The Son was created out of nothing and is therefore *different in essence* from the Father. He is Logos, Wisdom, Son of God, but so only by the *grace* of God and not in and of himself. (2) There was (before time began) when he was not; that is, he is a finite being. (3) He was created before everything else, and through him the universe was created and is administered. (4) The Logos became the soul of the historical Christ, and the human elements in the character of Jesus belonged to the Logos. (5) Although the incarnate Logos is finite and hence is not God, he is to be worshipped, since he is exalted far above all other creatures, and is both Ruler and Redeemer.

The discussions at the Nicene Council revealed the fact that there were three parties present: the strict Arians, the semi-Arians and the Alexander-Athanasian party. The latter party, with the help of Constantine and the Western bishops, secured the adoption of a creed (see CREEDS) which no strict Arian could subscribe to, since it declared that the Son is *identical in essence* (*homoousian*) with the Father. The semi-Arians, although they maintained that the Son was not *identical in essence,* but of *similar essence* (*homoiousian*) with the Father, were finally constrained to sign the document. Soon after the closing of the council the semi-Arians began to assail the Nicene creed, and finally, through the influence of Eusebius (q.v.), they secured the recall of Arius and his companions and the deposition and banishment of Athanasius. The sons of Constantine continued to favor the semi-Arian party, which included a large majority of the Eastern bishops; but the Western churches generally adhered to the Nicene creed. But the death of Constantius II in 361 and the accession of Julian left the Arian party without imperial support and Athanasius and his followers regained considerable influence in the east. The accession of Valens in 363, however, reversed the governmental policy and led to the fanatical persecution of the Nicenes. But the distracted condition of the Orient, due to the war with Persia, and the demoralized state of many of the bishoprics under Arian leadership, made it relatively easy for Theodosius the Great to espouse and support the Nicene party. A second œcumenical council held at Constantinople in 381 reaffirmed the Nicene creed with slight additions and curtailments, thus completing the victory of Nicara in favor of the full deity of the Son. Arianism was soon suppressed within the empire, but it continued for a long time to prevail among the barbarians. The conversion of Clovis, King of the Franks, to the orthodox faith in 496 was followed by a rapid decline of Arianism among the Teutonic peoples. (See ARIUS). Consult Gwatkin, H. M., 'Arianism' (in 'Cambridge Medieval History,' Cambridge 1911); Newman, J. H., 'The Arians of the Fourth Century' (5th ed., London 1888).

EDWIN KNOX MITCHELL.

ARIANO, ä'rę-ä'nō, Italy, town in the province of Avellino, 44 miles northeast of Naples, in one of the most frequented passes of the Apennines. In the limestone cliffs of the neighborhood caves have been hollowed out and serve as dwellings for many of the poorer classes. Earthenware is the chief manufacture. It is the seat of a bishop and contains a handsome cathedral. Pop. (1901) 17,650.

ARIAS, ä'rī-âs, Montanus Benedictus, Spanish Orientalist and editor of the Antwerp *Polyglot*: b. Fregenal de la Sierra, Estremadura, 1527; d. Seville 1598. He was educated at Seville and at Alcala, where he became distinguished for his proficiency in the Semitic

languages. He traveled through France, Italy, Germany, England and Holland and thus became acquainted with several modern tongues. About 1559 he took orders and attended the Council of Trent as consulting theologian to the bishop of Segovia. On his return he secluded himself in a cloister among the mountains of Andalusia in order to give his whole time to literature. Philip II drew him forth from his seclusion in 1568 and persuaded him to go to Antwerp to superintend and edit the 'Polyglot Bible,' projected in that city by the celebrated printer, Christopher Plantin. The work appeared in eight volumes folio between 1568 and 1573. Only 500 sets were printed and the greater part of them were lost at sea, on the way to Spain. The work was well received by all except the Jesuits, to whom Arias was strenuously opposed. Léon de Castro, a professor at Salamanca, brought charges of heresy against Arias because he had included much rabbinical matter in the work and the latter journeyed to Rome in 1575–76 to clear himself and was acquitted. Philip gave him a pension and made him court chaplain. He wrote several works dealing with the Bible, Jewish antiquities, etc., and also a history of nature and several Latin poems. The best known is his 'Jewish Antiquities,' attached to the 'Polyglot,' and also published separately. Consult Gorris, 'Vie d'Arias Montano' (Brussels 1842) and 'Memorias de la real Academia de la Historia' (Vol. II, Madrid 1832).

ARICA, ą-rē'ką, Chile, seaport in lat. 18° 29′ S. It is connected by rail with Tacna, capital of the province of that name, 45 miles distant, and so with La Paz, Bolivia; also with Valparaiso, 987 miles away. During the war between Chile and Peru it was bombarded by the Chilean forces and it passed into the possession of Chile in 1883. The chief exports were formerly silver and silver ore, copper, bark, chinchilla skins and alpaca wool; at present it is of importance as the only port in the province of Tacna and the terminus of the Arica-La Paz Railway, which carries by far the greater share of the outward and inward trade of Bolivia (q.v.). Loading and unloading is effected by lighterage, and there is safe anchorage in eight to nine fathoms behind the island of Alacran, which protects the roadstead. There are telegraphic stations, both cable and wireless. The shipping movement in normal years amounts to 400 or 500 overseas steamers and 200 to 300 coasters. Pop. (1916) about 6,000.

ARICHAT, ā'rē-shăt', Nova Scotia, seat of Richmond County. It is situated on Madame Island and is a seaport of some importance, being the centre of quite an extensive fishing and canning industry. Ships of all sizes find accommodation in its harbor, the commerce being important enough to warrant a United States consular agent. The town is the see of a Roman Catholic episcopate. Pop. about 2,500.

ARICI, ą-rē'chē, **Cesare**, Italian poet: b. Brescia, 2 July 1782; d. there, 2 July 1836. Under Bonaparte he was secretary of the departmental court in his native city. In 1810 he was appointed professor of elocution in the Brescia Lyceum. Later he became professor of history and literature and then professor of Latin. His chief works are 'La coltivazione degli olivi' (1808); 'La pastorizia' (1814); 'Il campo santo di Brescia.' A collection of his works was published under the title 'Opere' (6 vols., Padua 1858).

ARI'CIA, or **ARICCIA**, Italy, town 16 miles from Rome, on the famous Appian Way. It is one of the most ancient communities now surviving from classical times. Its name figures in history as early as 338 B.C., when it was conquered by C. Mænius. It has an old church, built by Vernini in 1664 near where once had stood a magnificent temple to Diana.

ARID LANDS. See DESERTS.

ARIEGE, ą'rē-āzh', France, inland department, bounded on the south by Spain, west and north by the department of Haute-Garonne, northeast and east by Aude. It has an area of 1,893 square miles and is for the most part mountainous. The climate is mild in the south, but naturally very severe among the mountains. Wheat, maize and potatoes are the chief crops. Good vineyards and market gardens are found in the north. Flax and hemp are also cultivated. The mountains afford excellent pasture, and a considerable number of cattle, sheep and swine are reared. Poultry- and bee-farming flourish. Forests cover more than one-third of the department and harbor wild boars and even bears. Game, birds of prey and fish are plentiful. There is abundance of minerals, including lead, copper, manganese and especially iron. Iron founding and forging are the principal industries. Flour-milling, paper-making and cloth-weaving may also be mentioned. The capital is Foix. Pop. (1911) 198,725.

ARIES, a'rī-ēz, ("The Ram"), in astronomy, the first sign of the Zodiac, denoted by the sign ♈, in imitation of a ram's head. The name is probably to be associated with the fact that when the sun is in this part of the heavens (in spring) sheep bring forth their young; this finds a parallel in "Aquarius," when there is much rain. It includes the first 30° of the ecliptic, beginning from the vernal equinox. The vernal equinox, sometimes called the first point of Aries, continually changes its position among the fixed stars because of the procession of the equinoxes, moving 50.2″ westward each year. For this reason the sign Aries has ceased to correspond with the constellation of the same name, as it did 20 centuries ago, when the ecliptic was divided into its 12 parts, each represented by a sign which was named after the group of stars through which it passed. At the present time the sign Aries is in the constellation Pisces, 30° westward of the original sign. It will require 24,000 years before the sign and the constellation again correspond.

A'RIMATHÆ'A, a town in Judea and according to Saint Jerome, not far from Lydda. It is mentioned in the Gospels as the home of Joseph, a member of the Sanhedrin, who had the honor of giving the burial place for the body of the crucified Christ. Joseph of Arimathea is also mentioned in Arthurian legends as having brought the Holy Grail from Jerusalem. Its site is not definitely known, but was probably Ramah, the home of Samuel in the hill country, the modern *Er Râm*, 19 miles northwest of Jerusalem.

ARIMINUM. See RIMINI.

ARION, a lute player of ancient Greece, native of Lesbos. He lived about 600 B.C. Herodotus tells the story that Arion was sent by Periander, tyrant of Corinth, to Italy to compete there in a great competition for musicians and singers. Arion went and so enchanted the judges with his playing that he won all the prizes. As he was returning home on a Corinthian ship, with all his rich prizes, Apollo appeared to him in a dream and warned him that the sailors were plotting to murder him. Whereupon he asked the sailors that he be permitted to play his lute once more. This request being granted, he stood on deck and began playing, whereupon the dolphins, fascinated by his sweet music, gathered thickly about the vessel. Then as the sailors were about to slay him, he leaped overboard. One of the dolphins lifted him up on its back and swam ashore with him, landing him safely on the promonotory of Tænarius, from which place he journeyed to Corinth. When the sailors arrived at Corinth they assured Periander that Arion was dead, whereupon they were confronted by him and then crucified. As proof of the truth of this story Herodotus points to the fact that there existed at Tænarus a bronze statue of Arion riding on the dolphin's back. The lute and the dolphin were raised to the constellations and the story became a tradition among the Greeks. It was said that Arion was the inventor of the dithyramb. A. W. Schlegel recites the story of Arion in one of his best poems.

ARIOSTO, ār-yōs'-tō, **Ludovico,** an Italian poet: b. Reggio, 8 Sept. 1474; d. Ferrara, 6 June 1533. His father, who was commander of the citadel of Reggio, proposed that he should study law, but, as he showed no indication of being fitted for this profession, he was finally permitted to follow his own inclinations. These led him to the study of literature, especially the classics, and he soon developed so much ability as a poet that, as early as 1495, he wrote several comedies. Two of them were acted about 1512, and they attracted the attention of Cardinal Ippolito d'Este, who sent him as an ambassador to the court of Pope Julius II. In 1517 he offended the cardinal by refusing to accompany him to Hungary, but he immediately entered the service of Alfonso, Duke of Ferrara, by whom he was appointed governor of Garfagnana, a position which he filled successfully for several years. The last years of his life were spent in writing comedies and in completing his principal work, a romantic epic, 'Orlando Furioso,' which has been called "the greatest poem of its kind in any language." His 'Satires' in the Horatian style were not published until after his death. His last days were spent in a modest home of his own in Ferrara. It has been carefully preserved. Recent editions of 'Orlando Furioso' are those by Casella (Florence 1877), and Popini (ib. 1903). His minor works were edited by Polidori (2 vols., Florence 1891) under the title 'Opere minori in verso e in prosa.' The best English translations are those by Sir John Harrington (London 1591), by Hoole (ib. 1783), and by W. Stewart Rose (ib. 1823). Consult the biography by A. Cappelli, in his collection of Ariosto's 'Letters' (Milan 1887); Giosuè Carducci, 'Studi su Ludovico Ariosto e Torquato Tasso' (Bologna 1905); Gardner 'The King of Court Poets: Ludovic Ariosto' (New York 1906), and De Sanctis 'Storia della Letteratura Italiana,' edited by B. Croce (Vol. II, Bari 1912). See ORLANDO FURIOSO.

AR'ISTÆ'US, a divinity of ancient Greece widely worshipped, but of whom few details are known. From what is known of the few fragments of the traditions of the period surviving in historic records, he was supposed to be the son of Apollo and Cyrene, the latter being the granddaughter of the river god Peneus. She was delivered to Aristæus on the coast of Libya. Another record has him born in Thessaly where he became the pupil of Chiron, the centaur. Numerous such stories survive, each probably representing a local tradition. Aristæus was the protector of the hunters and herdsmen and also was credited with having taught bee-keeping and the spinning of wool. All the traditions assign to him good qualities, as his name signifies.

AR'ISTAG'ORAS, satrap of Miletus. He was the son-in-law of Histiæus, whose influence at the Persian court obtained for him his position, in about the year 500 B.C. He attempted to conquer Naxos for the Persians, but failed. Anticipating punishment for his failure, he made a tour of the Ionian cities and persuaded them to join a general revolt against the rule of the Persians. He next appealed to Sparta, without success, but the Athenians came to his assistance with 25 ships and an army. At the head of the Greek allies, he attacked Sardis, 499 B.C. and burned it. But the Persians finally defeated him and he fled to Thrace, where he was put to death by the Edonians.

AR'ISTAR'CHUS, ancient astronomer, native of Samos, who lived in about the middle of the 3d century B.C. He was known as the chief exponent of the heliocentric theory of the universe; that the sun stood still and the earth and the rest of the universe revolved around it. Because of this he was accused of heresy. He was supposed to have written extensively on his science, but all that survives is a short essay on the sizes of the sun and the moon and his estimates of their distances from each other and from the earth. He was the first to attempt to work out this problem by trigonometry, but on account of not having accurate instruments for measuring his estimates were inaccurate, though his theory was sound enough. This essay was first published by Valla, in Latin (1498). Later it was issued in Greek and Latin by Wallis (1688). Consult Heath, 'Aristarchus of Samos, the Ancient Copernicus' (Oxford 1913).

ARIS'TEAS, a fabulous character of the ancient Greeks, sometimes styled the "Wandering Jew" of ancient Greece. He was accredited with supernatural powers, one of his practices being to leave his body and re-enter it at his own free will. It is therefore not surprising that he has been reported to have lived at various times over a period covering several centuries. His first appearance is as the teacher of Homer. Then, some generations afterward, he is born on Proconnesus, an island in the Sea of Marmora. Next he pays a visit to the Hyperboreans. On his return he dies. But a traveler reports having met him some time afterward and being accosted by

him. Seven years later he appears in the rôle of an author, and during this incarnation he composes an epic poem called 'Arimaspia,' which was copied by Herodotus and other writers of a later period. Over 300 years later he reappears in Metapontum, in southern Italy, where he advises the people to build an altar to Apollo, assuring them that Apollo had founded the city, for he had been present in the form of a raven and assisted at the ceremony. Consult Rohde, 'Der griechische Roman' (Leipzig 1900).

ARISTEAS, an official of Ptolemy Philadelphus, who is said to have sent him to Jerusalem, 273 B.C. with the mission of obtaining from the high priest there, Eleazar, a copy of the Pentateuch. Consult Schürer, 'Geschichte des jüdischen Volkes' (Vol. II, p. 819, 1886).

ARISTIDES, ăr'ĭs-tī-dēz, **Ælius,** ancient Greek orator: b. Hadrianoi Mysia, 129; d. Smyrna, 189 A.D. His father was Eudemon, a priest in the temple of Zeus. He was a pupil of the most famous rhetoricians of the period, among his teachers being Herodes Atticus of Athens and Aristocles of Pergamus. Having finished his education he made a journey through foreign countries, visiting Asia and Egypt and Italy. In Rome he gained the favor of the Emperor, Marcus Aurelius, over whom he maintained so powerful an influence that he was able to persuade him to rebuild Smyrna at Roman expense, the city having been destroyed by an earthquake. There are extant two rhetorical treatises and over 50 speeches ascribed to him, among the latter being six 'Sacred Speeches,' reporting the words of Æsculapius through his priests. The speeches of Aristides are often quoted as samples of Attic style. The writings ascribed to him have been edited by Dindorf (3 vols., Leipzig 1829). Consult Sandys, 'A History of Classical Scholarship' (Vol. I, Cambridge 1906).

ARISTIDES, Quintilianus, a famous Greek grammarian probably of the 3d century A.D., whose treatise on music is esteemed the most valuable of all ancient writings upon that theme. It was printed by Meibomius in his 'Antiquæ Musicæ Auctores Septem' (Amsterdam 1652) and was edited by Jahn in 1882. Consult Cäsar, 'Die Grundzüge der griechischen Rythmik im Anschluss an Aristeides' (Marburg 1861); Goodell, T. D., 'Chapters on Greek Metric' (New York 1902); Pauly-Wissowa, 'Realencyclopädie' (Vol. II, 894).

ARISTIDES, Saint, famous Greek convert to Christianity, who lived in about the 2d century A.D. In 1889 Dr. J. R. Harris found a complete copy of an 'Apology' for the Christian faith, written by Aristides, on Mount Sinai. It was a Syriac version of the original and was addressed to the Emperor Titus Hadrianus Antonius Augustus Pius. Previously only a fragment of this writing had been in existence, published in Venice (1878). Consult Harris, 'The Apology of Aristides' (in his 'Text and Studies,' 1891).

ARISTIDES, of Thebes, ancient Greek painter, who lived in about the middle of the 4th century B.C. He learned his art from his father, Nicomachus. His works brought very high prices. One of his most famous pictures was a great battle scene, showing over a hundred figures. His power of expression was best shown in the picture of a woman, lying wounded on a battlefield, fearfully attempting to hide the blood on her breast from her nursing child.

ARISTIDES THE JUST, an Athenian statesman: b. near the middle of the 6th century B.C.; d. about 468 B.C. He was the son of Lysimachus and belonged to one of the great Athenian families. He was one of the 10 generals of the Athenians when they fought against the Persians at Marathon, 490 B.C. According to the usual arrangement the command of the army was held by each of the generals in rotation for one day. But Aristides prevailed on his colleagues each to give up his day to Miltiades; and to this, in a great measure, must be ascribed the victory of the Greeks. In the following year he was elected chief archon. His policy aimed at constituting Athens as a land power and this brought him into direct conflict with Themistocles who advocated a naval policy. The conflict ended in the ostracism of Aristides about 485 B.C. A story is told that on the day of the voting, an ignorant voter asked Aristides himself to write the name "Aristides" upon his ostrakon. The latter asked him if Aristides had wronged him; to which the voter replied that he did not even know Aristides, but was irritated to hear him everywhere called "the Just." In 480 a general amnesty was decreed at Athens because of the threatening Persian invasion and Aristides returned to Athens and was elected strategus for 480–79. He loyally supported Themistocles in the Salamis campaign and annihilated the Persian garrison on the island of Psyttaleia. In the following year he commanded the Athenian forces at Platæa and arranged for the celebration of the victory over the Persians. About 477 Aristides commanded the Athenian fleet off Byzantium and, after the Ionian allies revolted from Pausanias, was offered the chief command and given full powers to fix the contributions of the newly-founded Delian League. His assessment was deemed most equitable and it is probably from this that he gained the title of "the Just." Soon afterward he yielded his command to his friend Cimon and returned to Athens where he continued to occupy a prominent place. Many ancient writers have represented Aristides as a democratic reformer, but there appears little justification for this as the period during which he shaped the national policy was one of conservative tendency. His estate suffered during the Persian invasions and he died poor, not leaving enough money to pay the expenses of his burial. A son and two daughters survived him and received state pensions. He was buried at Phalerum. Consult Herodotus VIII, 79–81, 95; IX, 28 Plutarch, 'Aristides' (translated by B. Perrin, New York 1901); Nepos, Cornelius, 'Vita Aristidis'; Meyer, E., 'Geschichte des Altertums' (Stuttgart 1901).

ARISTIDES, Apology of, a popular Christian theology written by Marcianus Aristides, an Athenian philosopher, in the 2d century A.D. (according to Eusebius, Hist. eccl. IV, 3). Little was known of the work until 1891 when Harris and Robinson published a complete Syriac version and proved at the same time that the greater part of the apology is contained in the legend of Barlaam and Joso-

phat extant in many Greek manuscripts and numerous translations. Since that time much attention has been paid to the work. It is addressed to Antonius Pius and has points of contact with the 'Kerygma' of Peter, the 'Shepherd' of Hermas, the 'Didache' and Justin, but more especially with the letter to Diognetus. After speaking of the true idea of God (chap. I) it takes up the origin of those nations which followed error and those which followed truth. The barbarians are treated in Chapters III–VII; the errors of the Hellenes in VIII–XIII, with an excursus on the Egyptians (XII). Chapter XIV is devoted to the Jews; and XV–XVII speak of the Christians, especially of their life and customs, in an attractive and instructive manner. Through the 'Apology' the name of Aristides gained a certain literary popularity among the Armenians. A homily 'On the Call of the Thief and the Answer of the Crucified' (Luke xxiii, 42–43) and a fragment of a letter 'To All Philosophers' are ascribed to him. Other names from the old Christian literature besides that of Aristides were applied to the literary frauds in Armenia from the 5th to the 7th century (cf. Conybeare, F. C., in *The Guardian*, 18 July 1894). The Greek and Syriac texts (the latter from a manuscript of Mount Sinai) were published by Harris and Robinson in 'Texts and Studies' (Vol. I, Cambridge 1891), translation of which appeared by Kay, D. M., in 'Ante-Nicene Fathers' (Vol. IX, pp. 259–79), and the Armenian text by the Mechitarists at Venice in 1878). Consult Harnack, 'Litteratur' (Vol. I, p. 96, 1893); Harris, J. R., 'The Newly Rocovered Apology of Aristides, its Doctrine and Ethics' (London 1891); Picard, M., 'L'Apologie d'Aristide' (Paris 1892); Seeburg, R., 'Der Apologet Aristides' (Erlangen 1894); Robinson, J. A., 'Apology of Aristides' (Edinburgh 1896); Krüger, 'History.'

AR'ISTIP'PUS, a disciple of Socrates, and founder of a philosophical school among the Greeks, which was called the Cyrenaic, from his native city Cyrēnē, in Africa; flourished 380 B.C. His moral philosophy differed widely from that of Socrates, and was a science of refined voluptuousness. His fundamental principles were that all human sensations may be reduced to two, pleasure and plain. Pleasure is a gentle, and pain a violent, emotion. All living beings seek the former and avoid the latter. Happiness is nothing but a continued pleasure, composed of separate gratifications.

ARISTOBULUS, Jew of Alexandria, who lived about 180 B.C., in the time of Ptolemy VII, whose teacher he was supposed to have claimed to have been. The work which brings his name down to modern times and of which only parts are still in existence was a commentary on the Pentateuch, in which he attempted to prove his theory that much of the literature of ancient Greece had been borrowed from that book. To uphold his view he quoted copiously from works supposed to have been written by Homer, Orpheus, Linus and Hesiod. He has been the subject of much controversy, many scholars, including Renan, Eichhorn, Wendland and others, contending that his work was not genuine. Their arguments are mainly based on the peculiar forms of the quotations and the supposed claim of Aristobulus to be the teacher of Ptolemy. On the other hand such authorities as Vlackenaer, Freudenthal, Clemen, Schlatter and Schürer maintain that Aristobulus may have taken his Greek quotations from some older Jewish writer, which would account for the similarity of their style to the Old Testament. A full discussion of the subject, together with a bibliography, is given in Schurer's 'Geschichte des jüdischen Volkes' (Vol. III, p. 512, 4th ed., 1909).

ARISTOBULUS I, prince of Judæa, son of John Hyrcanus, the high priest, whom he succeeded 104 B.C. His mother had been given the royal title, but on his father's death Aristobulus threw her into prison and allowed her to starve to death. He then assumed the kingly office as well as that of high priest. He was very much disliked by his people on account of his brutality, not only against his mother but his brothers as well, whom he caused to be murdered at the behest of Queen Salome. It is said that he was strongly inclined toward the Greek pagan worship, but on the other hand Josephus declares that he conquered a great deal of Iturean territory and forced the people to accept the Jewish faith. His reign lasted not over a year, when he died of an acute disease. Consult Welhausen, 'Israelitische und jüdische Geschichte' (p. 256, 3d ed., 1901).

ARISTOBULUS II, Jewish priest and ruler, son of Alexander Jannæus and Salome Alexandra, the widow of Aristobulus I (q.v.). He lived during the 1st century B.C., dying in the year 49. His brother, Hyrcanus II, was the rightful ruler and high priest, but Aristobulus succeeded in ousting him from both offices and installing himself, 69 B.C. The deposed brother appealed to Pompey, and after much indecision and intriguing Pompey finally declared himself against the usurper. In 63 B.C. Aristobulus' resistance was overcome and he himself was taken a prisoner to Rome. Seven years later he escaped, returned to Judæa and again raised an army against Rome. Again he was defeated and taken prisoner to Rome. Cæsar released him in 49 and sent him with the Roman troops to Judæa against Pompey, but some months later he was murdered by adherents of Pompey by means of poison.

ARISTOBULUS OF CASSANDRIA, ancient Greek historian: b. Chalcidice, about the middle of the 4th century B.C. In about 316 B.C. he went to Cassandria and became a citizen there. He accompanied Alexander the Great on his campaign into Asia. With this experience as a basis he wrote an historical work, the title of which remains unknown. Its text is preserved through the quotations of later writers, among them being Strabo, Plutarch and Arrian.

ARISTOCRACY.— (Greek *ἀριστοκρατία* from *ἄριστος* best, and *κράτος*, power). Etymologically, the rule of the best, but in its more usual significance, any system of government in which the right to govern is vested in a few; an oligarchy. From its strict political meaning and the fact that most aristocracies have been hereditary, it has taken on the secondary significance of any hereditary caste which has claimed or has been accorded a superior rank in social matters. The ancient Spartan state, the Athenian state before the Persian wars, the Roman republic are good

examples of communities where the aristocratic tendencies predominated. Though mediæval feudalism involved the existence of privileged classes, the dominating aspect of the system was a graduated hierarchy of absolute monarchs. It is on the break-up of feudalism and the origin of the Italian city-state or the subordination of the French and British petty lords to the king that we see the nobles again assume power by virtue of their membership of a privileged class and not by virtue of their territorial rule. When a weak monarch or dynasty came on the throne, as was the case with the house of Valois in France or the four Georges in England, it became easy for vigorous noble families to assume the real control of the state. At present the aristocratic system of rule survives in greatest measure in Germany and Austria-Hungary; in Great Britain the aristocracy has political power not so much through its constitutional position in the House of Lords as through the custom in many noble families of standing as candidates for seats in the House of Commons and the political prestige which attaches to their rank. See GOVERNMENT.

ARISTOLOCHIA, ą-rĭs'tō-lo-kĭ'ą, a genus of plants of the family *Aristolochiaceæ,* consisting of 180 species, mostly climbing, natives of tropical regions, a few occurring in temperate countries. The plants are remarkable for their curious flowers, the corolla-like calyx of which is tubular and usually variously bent and often showy. Many of them are cultivated, the best known being the Dutchman's pipe (*A. macrophylla*), a native of the southeastern United States, and the goose-flower, pelican-flower or swan-flower (*A. grandiflora*), native of tropical America, whose flowers bear a singular resemblance to a bird. The roots of some species are used in medicine, for example those of *A. serpentaria,* Virginia snakeroot, native of the eastern United States, and of *A. clematitis,* birthwort, a European species.

ARISTOPHANES. Modern comedy derives by way of Plautus, Terence, and Molière from the so-called New Comedy of Menander and his contemporaries. The so-called old comedy, of which Aristophanes is the only surviving representative, flourished 100 years earlier at the time of that Peloponnesian War which shook Greek civilization as the European War shakes that of Europe. There is no good single modern analogue of the old comedy. It is a blend of Shakespeare's 'Midsummer Night's Dream' with Bernard Shaw, musical comedy and a *revue de fin d'année.* It is extravaganza combined with the dramatic criticism of ideas and set off with occasional flights of true poetry and wood notes wild. So at least it appears in Aristophanes, who in native genius and spontaneous mastery of expression ranks with the four or five supreme poets of Greece. Though Aristophanes was easily the foremost representative of the old comedy, the extant fragments of his contemporaries, Eupolis, Cratinus and others, indicate that he found this comedy an already established literary form. It was presumably, like everything else in the world, an evolution. The performance of comedies at the winter and spring festivals of the wine god, Dionysus (the Lenæa and the Greater Dionysia) was for the Athenians a ceremony of the state religion. But modern attempts to trace the processes of the origin of comedy in primitive rites, revels and superstitions, and its development in imitation of tragedy are, in the absence of evidence, merely conjecture masking as science. They distract our attention from the broadly human literary aspects of that comedy and throw into false perspective the life, thought, politics and civilization of Periclean Athens, which were its real shaping environment.

Apart from his 11 extant plays little is known of Aristophanes' life. His first play, the lost 'Banqueters,' was produced in the year 427, like other of the earlier plays under the name of another comedian because, as Aristophanes tells us, in 'The Clouds' and in 'The Wasps' he was still too young to woo public favor in his own name. Whether this is literally and historically true or not it implies that he was a young man in 427 and may have been born between 448 and 455. His last extant play dates from 388 and he is supposed to have died between 385 and 375. An obscure jest in his 'Knights' implies that he was in some way connected with the island of Ægina, recently conquered by Athens — possibly because his father held an allotment of land there. The praise of country life and the pictures of rustic types in his plays indicate familiarity with the rural life of Attica and perhaps sympathy with the sturdy farming class, the backbone of sane, conservative democracy. But until the seige penned them within the long walls many Athenian families lived by preference on their country estates, and we need not assume that the lover of the country was himself a farmer or a bidder for the farmer's vote. In any case, Aristophanes is no less familiar with the city and the life and gossip of the young bloods about town. Plato in the 'Symposium' depicts him as dining with Agathon and in the company of that Socrates whom he had lampooned in his 'Clouds.'

His criticism of life and that of the old comedy generally is on the whole conservative, with many lapses into irresponsible and inconsistent buffoonery. He satirizes in strangely modern style the new thought, the new education, the new music, the new poetry, the new liberal theology, the new radical democracy and its demagogues. Modern critics, in reaction against naïve older interpretations, warn us not to take too seriously the criticism of life of one whose main purpose was to make the people laugh. The psychology of the possible mixture of motives is ingeniously analyzed in Browning's 'Aristophanes' Apology.' The predominating conservatism of Aristophanes may be due in part to the natural tendency of comedy to satirize the newness and in part to a genuine conviction that the progressives were moving too fast and that "Athens was dying of the triumph of the liberal party." It was not sympathy with the reactionary plots of the young aristocrats with whom Plato shows him in familiar association. Aristophanes was a true patriot and a sincere if critical democrat.

The first extant play, 'The Acharnians,' 425, turns on the fancy of a militant pacifist's establishing a private peace for himself while the state is at war. This happy thought is hotly debated in the first half of the play, and in the second half illustrated by farcical scenes of contrast between the riotous living of the

pacifist and the bread ticket diet of the war party. This way of composition gives the formula of many Aristophanic comedies. 'The Knights' (424), named from its chorus, is an open assault on the demagogue, Cleon, who is outfaced by a still more scurrilous ruffian who fights fire with fire. Aristophanes elsewhere informs us that Cleon dragged him or the poet who produced his lost 'Babylonians' into court on a charge of treason.

'The Clouds' (423, 2d. ed., 422) is a gross caricature of Socrates treated as representative of sophistry, the new education, atheism, and the new science of nature. The chorus of clouds symbolizes the mists of the new thought. In the second edition Aristophanes bitterly reproaches the audience for not giving the prize to this cleverest of his comedies. See CLOUDS, THE.

The happy thought of 'The Wasps' (422) is the institution of a court in a private house to satisfy the litigious mania of an old professional juryman, Love-Cleon, whose dashing son Hate-Cleon has vainly attempted all other means of restraint. The first case brought before the court is the trial of the house dog for stealing a Sicilian cheese, a motive borrowed by Ben Jonson. The chorus of wasps symbolizes jurymen and native children of the soil as they explain:

> "Do you wonder, O spectators, thus to see me
> spliced and braced,
> Like a wasp in form and figure, tapering inwards
> at the waist?
> We on whom this stern-appendage, this
> portentous tail is found,
> Are the genuine old Autochthons, native children
> of the ground;" (*Rogers*)

Many of the scenes are pure farce. In its larger purport the play may be a conservative satire on that palladium of advanced democracy, the huge popular courts in which from 500 to 2,000 jurymen as judges of both law and fact gave irresponsible decisions according to their own good pleasure and the plausibility of the orators.

'The Peace' (421) develops still further the motive of protest against the Peloponnesian War. Poor Peace has been buried out of sight, but the farmers and other men of good will with a long pull and a strong pull all together draw her forth and celebrate with wild revels her nuptials with their worthy leader Trygæus, who had sailed not across the ocean, but up to heaven on a black beetle in order to find out how to get the boys out of the trenches.

After 'The Birds' (414) the year 411 yields two comedies with similar motives. In 'The Lysistrata' the women of all Greece plot to enforce a peace by divorce from bed and board. In 'The Thesmophoriazusæ,' a licentious picture of the women celebrating the festival of Demeter is converted into a literary satire of Euripides, whom the women condemn for his well-known misogynism and whose representative caught spying upon them, they arrest and hold as a hostage. After 'The Frogs' (405), 'The Ecclesiazusæ' or 'Ladies in Parliament' (393) portrays the women of Athens seizing the reins of government and establishing a communism and community of wives, the relation of which to Plato's 'Republic' has been endlessly discussed. 'The Ploutos' (388) in its present form presents a tamed and subdued comedy of transition shorn of the chorus. The blind god of wealth recovers his sight by incubation in the temple of Æsculapius and the consequences are portrayed in scenes which caused the play to be much used as an edifying school book in the Renaissance and after. An earlier edition of 'The Ploutos' (408) is supposed to have been charged with political allusions to the restoration of wealth to Athens by the victories of Alcibiades. See BIRDS, THE; FROGS, THE.

The best complete translation of Aristophanes is that which accompanies the separate plays in Roger's edition. Convenient and accessible is the reprint in Morley's Library of Frere's racy rendering of 'The Acharnians,' 'The Knights' and 'The Birds.' Murray's translation of 'The Frogs' is masterly. No formal and printable translation can recreate the atmosphere of an Aristophanic comedy — the cumulative hilarity of the exuberant rush of puns, surprises, local hits and topical song allusions. Only an impressionistic viva voce version, compact of up-to-date analogies and equivalents, could approximate to that effect, and such a rendering, if printed, would lose its flavor and become more obsolete than Aristophanes himself in a decade. All histories of Greek literature give a chapter to Aristophanes. Croiset's 'Aristophanes and the Political Parties at Athens,' translated by James Loeb (London and New York 1909) is an admirable and very readable monograph. Consult also Conybeare, F. C., 'A Message from Aristophanes' (*Open Court*, Vol. XXX, pp. 41–59, Chicago 1916); Courtney, W. L., 'Aristophanes, the Pacifist' (*Fortnightly Review*, New York 1916); Petrie, R., 'Aristophanes and Socrates' (*Mind*, London 1911); Todd, O. J., 'Quo Modo Aristophanes Rem Temporalem in Fabulis Suis Tractaverit' (Harvard Studies in Classical Philology, Cambridge, Mass., 1915).

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ARISTOPHANES, The English, a name frequently applied to Samuel Foote (q.v.), also called "The Modern Aristophanes," because of his abundant good spirits and skill in unsparing ridicule. Garrick was a common object of his wit.

ARISTOPHANES, The French, a name sometimes applied to the French dramatist, J. B. P. Molière (q.v.).

ARISTOPHANES' APOLOGY, a poem by Robert Browning (q.v.), published in 1875; the title being in full, 'Aristophanes' Apology; Including a Transcript from Euripides: Being the Last Adventure of Balaustion.' It is a sequel to the poem 'Balaustion's Adventure.' A long work in blank verse, it commemorates the defense made by Aristophanes of his comic art, on learning through Sophocles of the death of Euripides, the tragedian. An extensive article on it may be found in Berdoe's 'Browning Cyclopædia' (1892), with a glossary of terms, etc.

ARISTOPHANES OF BYZANTIUM, Greek grammarian: b. about 262 B.C.; d. about 185. He was educated under Zenodotus at Alexandria, and became the chief librarian of the great Alexandrian library. Ancient critics rank him among the most celebrated critics and grammarians. He deserves great credit for his services to the Greek language and litera-

ture. With Aristarchus, he was the principal expert in determining the so-called Alexandrian canon of the classical writers of Greece. He invented a series of critical signs, and greatly improved the notation employed in prosody, including accent, quantity and breathing. His publications include important critical editions of Greek writers, particularly of Homer — the first of its kind — Hesiod and the lyricists Alcæus and Pindar. For the plays of the tragic and comic poets he wrote introductions. Little of what he wrote is extant, save fragments in the scholia of the poets, some *argumenta* to the dramatic writers, and a part of the Λέξεις ('Glossary'). Consult Nauck, 'Aristophanis Byzantii Fragmenta' (1848); Sandys, 'A History of Classical Scholarship' (Vol. I, pp. 126–131, Cambridge 1906).

ARISTOTELIANISM. Aristotle is the first philosophical writer to make a strict separation of the branches of philosophy. His writings, in terms of their subject matter, fall into the following groups: Logic, Metaphysics, Physics, Ethics, Politics and the Philosophy of Art. A classification made by Aristotle, but not applied to the arrangement of his writings, is: (1) theoretic philosophy; (2) philosophy of conduct; (3) philosophy of production, that is, of art. The analysis of the problems and subject matter of philosophy and science begins with him. In Plato's writings the various problems are fused together and treated integrally and synthetically in an ethico-metaphysical system.

Logic.—For Aristotle logic is a methodology of science, a propædeutic to the other disciplines. It is not strictly a science, because science has some essence or aspect of reality for its subject matter, while logic is concerned with the forms of knowing. Formal logic was founded by Aristotle and almost completely developed by him. Its chief feature is the doctrine of the syllogism, the process of reaching scientific or apodictic conclusions. The syllogistic process is a deductive process, that is, it derives particular conclusions from general principles or accepted premises. The possibility of deriving such conclusions rests upon the axiomatic principles of contradiction and the excluded middle, that is, two contradictories cannot at the same time and in the same reference be true; and of two contradictory propositions, one must be true and the other false, and a third intermediate proposition is excluded. The logical treatises were grouped together by Aristotle's successors and called the Organon or instrument of science. The several treatises consist of the Categories, the Hermeneutics, the Analytics and the Topics. The Categories discuss simple terms; the Hermeneutics discuss the combination of terms with a predicate, that is, the judgment or proposition; and the Analytics and Topics discuss the combination of propositions in the syllogism. The syllogistic conclusion is the derivation of one judgment from another by means of a middle term. The notion, judgment and conclusion are the three elements with which formal logic operates. The categories, or general notions under which reality is viewed, are enumerated by Aristotle as substance, quantity, quality, relation, place, time, position, possession, action, passion. These ten categories are evidently not derived from any single principle and are neither exhaustive nor mutually exclusive. Aristotle's main interest is in the syllogism; simple terms or notions and the judgment are scantily treated. His treatment of the syllogism is practically exhaustive. Modern logic has supplemented his work by adding to his theory of the categorical conclusion, which was his chief interest, the theory of hypothetical and disjunctive conclusions; further, by adding a fourth figure to his three, and lastly by developing the theory of inductive logic and the method of the sciences. Aristotle regards deductive logic as the only method that can furnish demonstration or apodictic conclusions. Science, however, would not be possible with syllogistic demonstration alone, for if all our premises had to be proved we should be forced into an endless regress. Therefore, science must accept certain fundamental principles as its axiomatic postulates. From these accepted postulates scientific proof proceeds by deduction. In addition to this Aristotle mentions the further method of induction without elaborating it, saying, however, that universal principles are secured by it from particular instances and that it has the advantage over deduction by being nearer to our sense experience and therefore more generally intelligible. On the other hand, he insists that a complete knowledge of particulars is necessary to a completely certain induction, and this, owing to the multiplicity of particulars, being rarely possible, induction lacks in its conclusions the cogency of the deductive syllogism.

Metaphysics.— First Philosophy (the term Metaphysics is not used by Aristotle, but is a word applied to the First Philosophy on account of its being placed after the treatises on Physics by the early editor of the works) is the philosophy of first principles as such; second philosophy or physics is the philosophy of these principles applied to concrete phenomena, the phenomena of motion and matter. Aristotle is a disciple of Plato and, like his master, he viewed the world from the standpoint of teleology. The cosmic processes are determined by final causes. He makes more of facts than Plato does, has a much larger mass of empirical data for his constructions and is more catholic in his scientific interests. His metaphysics, however, like Plato's, is based on high speculative ideas and he explains the world-order by means of these general and ultimate principles, so that he is not a realist in the sense of confining reality merely to particular facts. Like Plato, he sought the essence of phenomena in the concept and law, but unlike Plato he sought it in a concept given in the phenomena as their inner principle of development and not in a transcendent principle. If there is no concept or universal there can be no scientific knowledge. The concept is not, however, an idea isolated from particular things, but as the universal reality it is immanent in particulars (*universalia in re* not *ante rem*), the individual being the only self-existent real. Against Plato's doctrine of ideas Aristotle brings the following criticisms: (1) The Platonists furnish no adequate proof of the existence of ideas as hypostasized entities; (2) The Platonic ideas, because transcendent, cannot explain the phenomenal world, which is left without a principle of motion; (3) The world of ideas

is only a reduplication of the world of sense in its generic aspect; (4) The explanation of the relation of the ideal to the sensible world by the terms archetype, pattern, image, etc., is only metaphorical. The universal is real as the formative principle in things, giving to them their generic character, while matter is the principle of individuality. Form and matter are explanatory of genus and individual. In every particular thing, with the exception of God or the Prime Mover (who is pure form), the two principles of form and matter are present; form making the classification of things and scientific knowledge possible, and matter making possible the concreteness of objects. Form and matter are two aspects of individual things and are not really, but only notionally, separable. Everything is both form and substrate, idea and matter, significance and stuff, soul and body, with the single exception of the Supreme Being. Form is the moving principle of development and matter is the passive potentiality. Plastic stuff or matter is molded after generic patterns. In nature's processes Aristotle calls them energy and potentiality. The real is an explication of a prior potential. The transition of a thing from a condition of potentiality to a condition of actuality is accomplished by some form of motion. Motion in turn (which is of several kinds: spatial, that is, locomotion; qualitative, that is, transmutation of substances; quantitative, that is, growth) implies a moving cause, and any given moving cause an antecedent cause and so the causal regress would be endless, were we not to posit a Prime Mover or uncaused First Cause. The First Cause is the origin and source of all motion and life. As motion is eternal, so the Prime Mover is eternal; it is also immaterial, passionless and motionless, for the Prime Mover causes motion merely as an ideal toward which matter strives in the processes of nature, analogously to the power of attraction in beauty. The activity of God is pure thought or thought turned upon itself, which theoretic life is for Aristotle the perfect type of life. Between God, as pure form, and matter, as formless stuff — the extreme cosmic principles — Aristotle places the world of natural phenomena, which are all composites of the two principles. His doctrine of the Prime Mover is a direct product of his philosophy and is the first attempt to found a theistic theory on a philosophical basis. Aristotle specifies as the four causes operative in nature the formal, final, efficient, and material. But as form contains within itself the principles of efficiency, purpose and meaning, these four causes are reducible to his dualism of form and matter. As an example of his application of the four causes, a statue presupposes: (1) matter, for example, clay, wood or marble; (2) a form or idea in the artist's mind; (3) an efficient cause, such as the energy applied to tools; (4) a motive or purpose.

Physics.— While the metaphysics treats of being as such, of the unconditioned, of the ultimate principles explanatory of reality, Physics treats of the contingent, the conditioned and of the quantitative and qualitative relations of things. In the philosophy of nature's phenomena, the concept of motion plays the chief rôle, effecting the transition of potentiality to actuality and having its ultimate source in the Prime Mover. The whole of growth and development proceeds from one form of being to another form of being, but not from nothing to something, or from non-existence to existence. For Aristotle as for all the Greek philosophers the maxim holds: *ex nihilo nihil fit.* Inert matter is the most formless element in nature and man is the stage in which the highest form manifests itself. Between these nature exhibits a graded scale of development, that is, from the most inorganic to the highest organism. This scale itself is static and not a scale of evolution in the modern sense. The scale of beings is a fixed cosmic hierarchy, not determined by protoplasmic conditions plus environment. The Aristotelian world is a teleological system, the eternal forms working themselves out in plastic and contingent matter with reference to fixed final goals, the whole exhibiting plan, not planless, as Aristotle says, "like a bad tragedy." As the Prime Mover is perfect so the world shows that degree of perfection which is possible with the contingency and imperfection of matter. God is both *in* the world and *outside* of it as the transcendent cause of its order, just as the discipline of an army is in the army and outside of it in the person of the general. The universe is conceived by Aristotle to be spherical in form, not infinite. Its periphery consists of the region of the fixed stars, which revolve in a perfectly circular motion. They do not move freely in space, but are attached to the ethereal body of the outer heaven and move as a rider in a chariot. Their motion is caused immediately by the Prime Mover and being nearest to him, their motion is most perfect. The earth is at the centre of the universe and is fixed. Between the centre and the circumference are the seven planets, including the sun and moon. The motion of these, although concentric with the circumference, is less perfect, deviating from an exact circle. The earth is the region of rectilinear motion. The general presuppositions of motion are space and time. Space is, in Aristotle's conception, strictly speaking, only place, that is, it is the room occupied by body, and time is the measure of motion with reference to earlier and later. Motion being endless, time as the measure of its discrete moments is infinite. Space is finite, for there is no space outside the corporeal world. The elements in the cosmos are fire, earth, air, water and ether. Of these the first four are sublimatory. The celestial spheres consist of pure ether.

Psychology.—Aristotle defines soul as the "complete realization of a body endowed with the capacity of life." Every body, therefore, that has life, has soul, and psychology in the narrow sense would be a branch of biology. The physical world, according to Aristotle, is divided into two realms, the inorganic and the organic. The characteristic mark of the latter is the possession of life, or "soul." Soul is synonymous with the principle of life, by virtue of which a thing is endowed with the power of self-movement. Life is the universal form of organic activity, feeling and reason are specific forms of the same power. The highest manifestation of psychical activity is rational thought. There are four main forms in which life manifests itself: (1) Nutrition, growth, decay and the power in things to reproduce,

each after its kind, whereby the continuity of life is maintained; (2) locomotion; (3) sensation; (4) reason. These various types of life are forms of self-movement. The first form is found in the plant world as well as in the animal world, the last three only in the animal world. Soul as life is found in every part of the body, to which it is related as form to matter. The heart as the anatomical and physiological centre is also the life-centre. The heart, therefore, and not the brain, is the organ of consciousness, for consciousness is one of the forms of life. The processes of knowing or conscious life are developed in these stages: (1) sensation; (2) imagination, the power of using images of absent objects, combined with memory; (3) rational thought. Reason, according to Aristotle, is two-fold, creative and passive. All knowledge, in the last analysis, is derived from sense-perception. The mass of sense-perceptions which are held together by memory and stored in the central sense (*sensorium*) are the passive reason, that is, they constitute the matter which the creative reason transforms into conceptual knowledge. The two stand related to each other, therefore, as form to matter, actuality to potentiality.

Ethics.—The ethics of Aristotle consists mainly in a theory of the final end of conduct or the *summum bonum* and an account of the individual virtues. The chief good is happiness (well-being), which is defined as "activity of the reason in accordance with virtue in a complete life." This conception of happiness as consisting in theoretic activity is based on the peculiar function of man. Reason being the differential mark of man, his peculiar good should be discoverable in the activity of reason. Further, the good consists in the realization of the rational self in an ethical life that is complete and not of fragmentary duration, for "one swallow does not make spring." The virtues of an individual are divided into ethical and dianoëtic. The ethical virtues are liberality, temperance, justice, courage, friendship, high-mindedness, gentleness, veracity. The dianoëtic virtues are wisdom, art, insight, cleverness and such excellencies as attach to the theoretic activity, while the moral virtues are reasonableness expressed in action. Virtue is the power or persistent quality in an individual which enables him to perform his function well. Aristotle otherwise defines it as a "moral habit based on a life of deliberation, and expressed in the observance of a rational mean." The connecting link between ethics and politics is found in the social virtue of friendship.

Politics.—Aristotle gave to politics the position of an independent science, which he based on the study of over 150 actual constitutions. Politics, as the architectonic science, considers the complete good of man, for it is only in the state that man's full realization is attained, and man is by nature a "political animal." Ethics is, therefore, a branch of politics. Although the state is notionally prior to the household and village, it is preceded by them in the order of development. The state is such an aggregation of households and villages as to be self-sufficing. While it comes into being primarily for the sake of life, its growth is determined by the interests of a good and complete life. The individual is not self-sufficient. The end of the state is not power, or the protection of life, property or industry, but the promotion of noble life in its citizens and the happiness that springs from such life. The function of the state is educational and moral. One has to keep in mind that the Aristotelian state is a city-state and not an empire. The various forms of good constitutions are: royalty (rule of one), aristocracy (rule of few), polity (rule of the entire people). The corresponding corrupt forms are tyranny, oligarchy and democracy. The best constitution under most actual conditions is the polity, a constitutional democracy, which more than any form of government embodies the principle of the mean and on the average best meets the demands of the greatest number. Under completely ideal conditions monarchy is the best form of government.

Art.—Art has for its function partly the supplementing of nature and partly the imitation of nature. Nature has left man naked and defenseless, but provided him with the "tool of tools," a hand. The useful arts serve the interests of life; imitative and decorative arts serve the ends of noble pleasure and relaxation. The Aristotelian exposition of the philosophy of art is confined almost entirely to the extant fragment of the 'Poetics,' in which scarcely more than the theory of tragedy has survived. The function of tragedy is described as catharsis. The conclusion of a tragic representation that is true to the principles of art has the cathartic effect on the spectator of purifying his emotions by the instruments of pity and fear.

History of Aristotelianism.—Aristotelianism was continued in the peripatetic school (the name "peripatetic" came from Aristotle's method of giving instruction while walking, or from the walks—*περίπατοι*—in the Lyceum's grounds) down to 529 A.D., when the Emperor Justinian closed all the Athenian schools. During the early Middle Ages it was kept alive by the works of Boëthius and the 'Isagoge' of Porphyry. Later by its fusion with the theology of Thomas Aquinas it became practically the official philosophy of Roman Catholicism, which it still continues to be. The Arabs in Spain were the bearers of Aristotelianism to mediæval Europe, and by 1220 almost all of Aristotle's works had been translated from the Arabic into Latin. A little later, by the efforts of Thomas Aquinas, they were translated from Greek originals, and Aristotle's authority in science became well-nigh absolute. With the rise of Humanism Aristotelianism began to wane, and with the development of modern science and the Cartesian philosophy his influence outside the Catholic Church was to a large extent nullified. Within the Church, however, during the last quarter of the 19th century, through the efforts of Leo XIII, the influence of Thomism and Aristotelianism increased.

Bibliography.—Bonitz, 'Metaphysics' (1848); Butcher, 'Poetics' (London 1902); Bywater, 'Poetics' (Oxford 1909); id., 'Ethics' (1890); Jowett, 'Politics' (1885); Hammond, 'Psychology (1902); Navarre, 'Essai sur la rhétorique grecque avant Aristote' (Paris 1900); Newman, 'Politics' (1887); Sandys 'Constitution of Athens' (London 1893); id., 'Rhetoric' (Cambridge 1877); Ramsauer, 'Nicomachean Ethics' (1878); Spengel, 'Rhetoric' (1867); Wallace, 'Outlines of the

Philosophy of Aristotle' (Oxford 1883); Wilamowitz, 'Constitution of Athens' (Berlin 1891); Stahr, 'Aristotelia' (2 vols., 1830–32); Grote, 'Aristotle' (2 vols., 2d ed., 1880); Grant, 'Aristotle' (1874); Lewes, 'Aristotle, a chapter from the History of Science' (1864); Siebeck, 'Aristoteles' (1899); Prantl, 'Geschichte der Logik im Abendlande' (4 vols., 1855–70); Zeller, 'Aristotle and the Earlier Peripatetics' (2 vols., 1897).

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ARISTOTLE, Greek philosopher, and one of the greatest thinkers and scientific investigators and organizers the world has ever seen.

Life.— Aristotle was born in 384 and died 322 B.C. His birthplace was Stagira (hence he is often called "the Stagirite"), a city on the Thracian peninsula known as Chalcidice, which was at that time thoroughly Hellenic country, enjoying all the advantages of Greek culture. His father, Nicomachus, was the court physician and friend of the Macedonian King Amyntas. The medical profession is said to have been hereditary in his family, and the scientific and medical atmosphere in which he grew up probably helped to form his mind in those habits of accuracy and exactness for which he is famous. Both parents having died, his education was directed by Proxenus of Atarneus. In 367 B.C., when in his 18th year, Aristotle came to Athens, and became a member of the Academy, the school of Plato (q.v.). Here he remained until the death of Plato, 20 years later. Before this time, he had become renowned for his scholarship and brilliant writings, as well as through his public lectures on rhetoric. Doubtless he had also already developed to some extent his own philosophical views. There seems to be no truth in the charges that were brought against Aristotle by later writers, that he was guilty of ingratitude and active hostility toward his teacher, Plato. As we have seen, he remained a member of the Academy until Plato's death, and in his later writings, although criticising with keen insight certain Platonic doctrines, he speaks of his master with the greatest reverence and affection (cf. Zeller, 'Aristotle and the Earlier Peripatetics,' Vol. I, Chap. I).

After Plato's death, Aristotle resided for three years at the court of Hermias, ruler of Atarneus, who had been at one time a member of the Academy, marrying there Pythias, the niece, or, as some say, the daughter of the Prince. Hermias, however, was treacherously put to death by the Persians, and Aristotle withdrew to Mitylene. Soon after (343) Aristotle was called by Philip of Macedon to undertake the education of his son Alexander, the future conqueror of the world, then a boy of 13 years. Nothing is known regarding the nature of the education which Aristotle gave to his distinguished pupil. The regular instruction of the Prince must have ceased three years later when he was made regent by his father and entrusted with military duties. Aristotle remained in the north engaged in scientific work, though probably still retaining some connection with the Prince and the Macedonian court. When Alexander set out upon his campaign in Asia, Aristotle went to Athens and founded there his school. Its place of meeting was the Lyceum, a gymnasium attached to the temple of the Lycean Apollo. He was accustomed to talk to his pupils as he walked to and fro in the gardens of the Lyceum, and from this custom the school became known as the "Peripatetic" (*περιπατεῖν*, to walk up and down).

Here Aristotle taught and directed the various scientific activities of the school for 12 years (335–323). This school was not merely an institution for imparting instruction. It was also an intimate association of scientific workers, many of them, like Theophrastus (who succeeded Aristotle in the leadership), mature men and ripe scholars. The organization and direction of the investigation as well as the fruitful utilization of materials and synthesis of results were, however, the work of the master. During these years, Aristotle systematized the knowledge of the past, and thus defined the limits and laid the foundations of the sciences of the western nations. But he did more. He carried on investigations and extended the boundaries of knowledge in almost every field. In logic, metaphysics, ethics and politics, he reached conclusions that are of great and permanent significance for all time. Moreover, in psychology, zoology, physics, astronomy, æsthetics, and also in his historical investigations, his work is of the greatest value and importance for all the subsequent development of these sciences. See ARISTOTELIANISM.

After the death of Alexander the Great, the Greek states, with Athens at their head, attempted to free themselves from the Macedonian power. Aristotle's former relation to Alexander, and his friendship for Antipater, the Macedonian governor, made him at once an object of attack. The charge of Atheism was brought against him, as it had formerly been brought against Anaxagoras and Socrates and he retired to Chalcis in Eubœa, where, in the following year (322), he died.

Writings.— The writings that have come down to us under the name of Aristotle do not by any means represent his complete literary activity. It is moreover known that the writings of Aristotle which were lost included: (1) Certain popular works published by Aristotle probably during the time of his connection with the Academy. He himself refers to these as the "exoteric," or popular writings. They were written generally in dialogue form, and modeled, both in subject matter and style, after the works of Plato. (2) Compilations of scientific, historical, and political materials, which were used by Aristotle as data in the preparation of his theoretical works. To this class belongs the 'Constitution of Athens,' fortunately discovered in nearly complete form a few years ago and published in 1891 (English translations, by F. G. Kenyon and E. Poste, both London, 1891).

The works which have survived are those which set forth Aristotle's system in more complete and systematic form, and which were used within the school. The writings which have been known to tradition as those of Aristotle appear to have come essentially from the edition of Aristotle's works prepared and arranged by Andronicus of Rhodes about the middle of the 1st century B.C. Of present-day editions of Aristotle's works that of the Berlin Academy

(1831–70) may be mentioned. These writings may be classified in the following way:

(*a*) *Treatises on Logic.*— These were later collected under the title of the 'Organon.' This included the 'Categories,' 'De Interpretatione' (on the parts and kinds of propositions); the 'Analytics,' prior and posterior (consisting of two books each, and developing the doctrine of the syllogism and dealing with scientific methods in general); the 'Topics' (dealing with probable conclusions); and on 'Sophistical Elenchi' (which discusses certain fallacies and the ways of refuting them). The Bohn Library gives an English translation of these works in two volumes by O. F. Owen.

(*b*) *The 'Rhetoric' and the 'Poetics.'*—The former consists of three books, of which only the first two are regarded as genuine. (English translation by T. Buckley in Bohn Library). The 'Poetics' has been preserved only in a very incomplete and fragmentary condition. An English translation is given in S. H. Butcher's 'Aristotle's Theory of Poetry and the Fine Arts' (3d ed., 1902). See POETICS, THE.

(*c*) *The Work 'On the First Philosophy'* — our 'Metaphysics' — which Zeller describes as a torso arbitrarily bound up with a number of other fragments, some genuine, some spurious. (English translation in Bohn Library, by J. H. McMahon, 1889).

(*d*) *The Works on Natural Science.*— To this class belong (1) the 'Physics,' with the connected works, 'On the Heavens,' 'On Growth and Decay,' and the 'Meteorology'; and (2) the zoological treatises, 'The History of Animals,' 'On the Parts of Animals,' 'On the Movement of Animals,' and 'On the Generation of Animals'; (3) the psychological writings, including the 'De Anima,' and the smaller treatises known as the 'Parva Naturalia.' Of these works 'The History of Animals' is translated by W. Cresswell in the Bohn Library; 'On the Parts of Animals' by J. Ogle (1882); the 'De Anima' by E. Wallace (1882), and W. A. Hammond (1902). The latter writer under the title 'Aristotle's Psychology' has given also a translation of the 'Parva Naturalia.'

(*e*) *The Ethics and Politics.*—Aristotle's treatise on ethics is known as the 'Nicomachean Ethics.' It has 10 books, of which books V to VII are largely made up of additions from the 'Eudemian Ethics.' This latter work is a revision of the Aristotelian ethics by Eudemus, of which only a part has been preserved. The 'Nicomachean Ethics' has often been translated into English. Two of the most recent and best translations are those of F. H. Peters (4th ed., 1891), and J. E. C. Welldon (1892). The 'Politics,' in eight books, was left in an incomplete and fragmentary condition. (English translations by B. Jowett and J. E. C. Welldon). See ARISTOTELIANISM and consult works there referred to.

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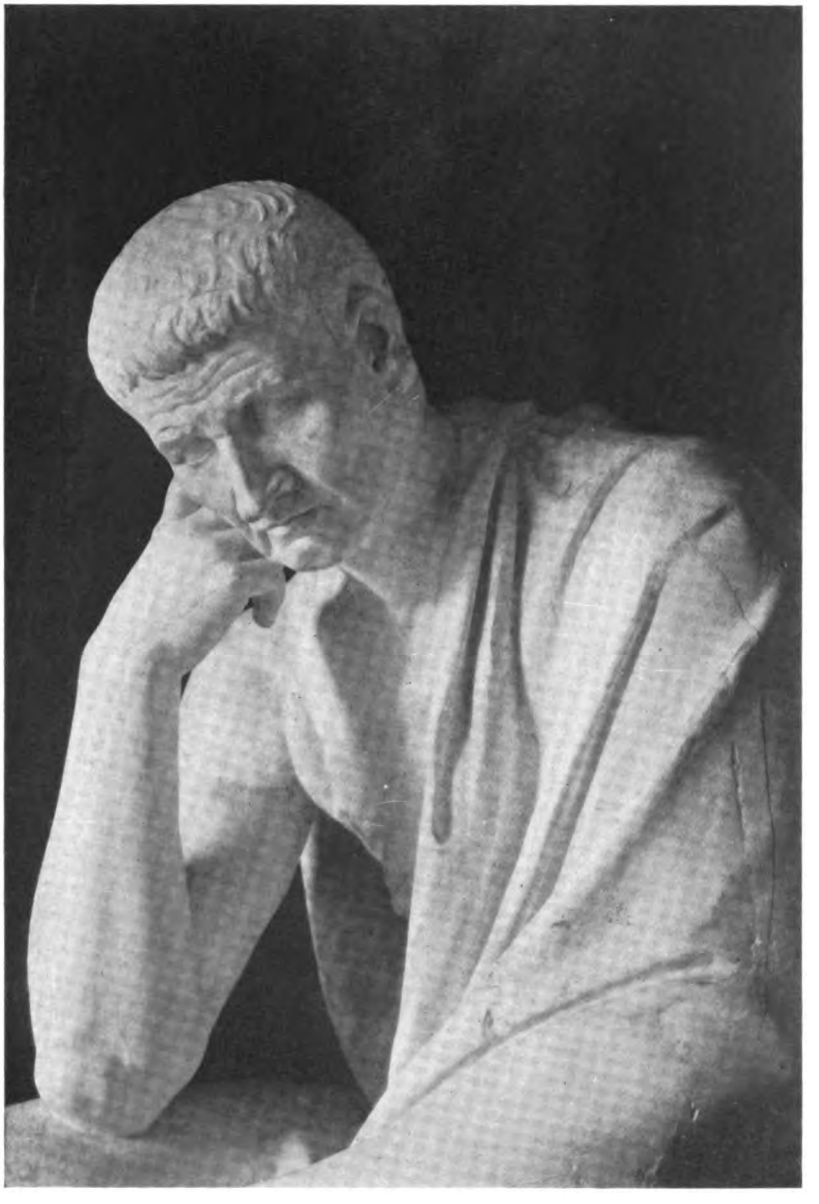
ARISTOTLE'S LANTERN, the complex dentary apparatus or oral skeleton and associate soft parts of a sea-urchin (q.v.). The oral skeleton attains its highest development in the *Echinidea* in the Aristotle's lantern of the sea-urchins. The lantern is composed of 20 principal pieces — five teeth, five alveoli, five rotulæ and five radii — of which the alveoli are again divided into four pieces each, and the radii into two, thus making a total of 40 pieces. This complex apparatus has, beside the inter-alveolar muscles, protractor, oblique, transverse, and retractor muscles. A somewhat similar but less complicated oral skeleton is found in the *Clypeastroida.*

ARISTOXENUS, Greek musician and philosopher of Tarentum, flourished about 350–324 B.C. He was one of the oldest writers, and probably was the greatest of Greek students of the science of music and all its branches. He was a son of Spintharus, who taught him music, having himself studied under Socrates and being possessed of a great knowledge of musical matters. After having received his elementary education he went to study music under Lamprus of Erythræ, and later became a student of philosophy under the Pythagorean Xenophilus of Chalcidice. He afterward went to Athens to study philosophy under Aristotle, and made such rapid strides that, upon the death of Aristotle, he aspired to be his successor and head of the philosophical school; Theophrastus was, however, appointed in his stead. He founded a school of musicians, who were called, after him, Aristoxeneans. The main difference between the systems of the Pythagoreans and the Aristoxeneans lay in the fact that the latter judged of the notes in the diatonic scale exclusively by the ear, while the former determined these mathematically. The only one of his works of any value now extant is a treatise on music, 'The Elements of Harmony.' It was published in three volumes by Meursius in 1616. There is an English translation by Marcran (Oxford 1902). The best edition is that by Marquard (Berlin 1868). Consult Goodell, T. D., 'Chapters on Greek Metric' (New York 1902); Laloy, 'Aristoxène de Tarente et la musique de l'antiquité' (Paris 1904); Westphal, 'Melik und Rhythmik' (Leipzig 1893); Mahme, W. L., 'Diatribe de Aristoxeno' (Amsterdam 1793).

ARISUGAWA, ä'rē-soo-gä'wą, the title of a noble Japanese family founded in the 17th century and prominent in civil and military affairs. This ancient family was founded by the seventh son of the Mikado Go-Yozei, during his reign from 1587 to 1611. The members of the family did not, however, attain much prominence until January 1868, when Arisugawa Taruhito (b. Kioto, 1835; d. 1886), who was the uncle of the Mikado, was appointed supreme administrator and commander-in-chief of the army. It was at this time that the duarchy of Mikado and Shogun was abolished and the present form of government established, with the Emperor Mutsuhito as dictator with undivided power. Upon taking office he at once reorganized the army to put down the rebellion in the north, led the imperial troops against the rebels, completely routing them and saving Yedo from destruction. After this he began military operations in the north, and by his skillful manœuvres soon brought the rebels to terms and the war to a quick conclusion. The next year, in 1869, he returned the sword of justice and the brocade banner, which he had received at the beginning of his campaign against the rebels, to the Emperor, thus signifying that he had brought the



ARISTOTLE

empire to a state of complete subjugation. In 1875 he became president of the senate, and again in 1877 was placed in command of the forces sent to suppress the Satsuma rebellion, under the leadership of Saigo Takamori. This was a long and severe test of his military ability, and his success, though won only after seven months of hard fighting and the sacrifice of 20,000 soldiers and $50,000,000, showed him to be a leader born of the highest order of military genius. For this great service the Emperor decorated Arisugawa with the Order of the Chrysanthemum and appointed him field-marshal and junior Prime Minister. A superb bronze equestrian statue of Arisugawa Taruhito on a lofty granite pedestal stands in Tokio.

ARISUGAWA Takehito, b. 1862; d. 6 July 1913; brother of the above, was adopted by him as his heir and was also heir presumptive to the throne till 1879, when a son was born to the Emperor. He served three years in the British navy, commanded a cruiser in the war with China (1894–95) and later served as superintendent of the naval base at Yokosuka. He was guardian of the person of the Crown Prince in 1902–03, represented the Emperor at the marriage of the German Crown Prince in 1905 and later visited England as the guest of Edward VII. Takehito's only son died in 1895 while serving as a naval cadet. In the ordinary course the house would become extinct, but in view of the special relation of the house to the court, the Emperor ordered his third son, Prince Nobuhito Terunomiya (b. 3 Jan. 1905) to become, on attaining his majority, the head of the Arisugawa House.

ARITA, ä-rē'tä, a Japanese town in the western part of Kyushu, famous for its pottery works, dating from the end of the 16th century. The Arita porcelain is highly esteemed.

ARITHMETIC. This word has been and still is used in two quite distinct senses. It formerly signified merely the science of numbers (see ARITHMETIC, HISTORY OF), and treated such numeral properties as seemed mysterious or peculiar. With the invention of algebra it was often taken to include such portions of that science as referred to the operations and to the number theory. In this sense it is still used in Germany and France to-day, the art of computation being indicated by the names *Rechnung* and *Calcul.* In English, however, the term early came to be applied to both the science of numbers and the art of computation. As the former branch developed the advanced portion was given the distinctive name of Theory of Numbers (q.v.), leaving the name Arithmetic to apply to calculation and its application to business problems. With the recent relegation of the progressions and the roots to algebra, this is the sense in which the word is used in the United States to-day. With this understanding of the term, the leading topics relating to the subject will be considered.

I. Notation and Numeration.—The former referring to the number of symbols is from the mediæval Latin *notæ,* meaning the numeral characters (see NUMERALS), and the latter, referring to number names, is from *numerus,* number. The distinction between the terms is coming, however, to be less marked than formerly, the word numeration being used for both. The writing and reading of numbers generally refers to positive integers, common fractions (or vulgar fractions, so called to distinguish them from the *fractiones physicæ* or *astronomicæ,* the old sexagesimal fractions still met in angle measure), decimal fractions, compound numbers and surd numbers. Of these the positive integers are known as natural numbers, the others as artificial numbers. Negative numbers, also belonging to the artificial group, have until recently been excluded from arithmetic. They have, however, so many practical applications that they are beginning to find a place, and in time they will probably be treated in arithmetic so far as necessary for cases involving numbers of opposite nature, like debit and credit, opposed forces, and contrary directions.

The distinctive feature of our present numeral system (see NUMERALS) is its place value. The characters for 5 and 1, written in juxtaposition, indicate addition in the Roman system (VI); but in the Arab-Hindu notation (51) they indicate 5 *tens* and 1 unit, the 5 having a place value showing that it represents tens. Thus by means of only 10 characters we are able to write numbers of any desired magnitude, and by means of the simple device of decimal fractions we are also able to represent any numbers, however small.

II. Scales.— Because man has a natural counting apparatus in his 10 fingers (see FINGER NOTATION) the world has come to write numbers on a scale of 10, and to give them names based upon a decimal system. We might use other scales, and the duodecimal (scale of 12) would be better on several accounts, although a change is not practicable. There has always been some tendency to use the scale of 12, as is seen in such tables as 12 inch=1 ft., 12 oz.=1 lb. troy. The superiority of the duodecimal over the decimal scale lies in the fact that 12 has more exact divisors than 10 has. Therefore the fractions most commonly employed could better be represented on the scale of 12, as is here shown:

	Scale of 10	Scale of 12
½	0.5	0.6
⅓	0.333...	0.4
⅔	0.666...	0.8
¼	0.25	0.3
¾	0.75	0.9
⅛	0.125	0.15
1/12	0.08333...	0.1

In the tables of denominate numbers the tendency formerly was to adopt a varying scale, but at present it is entirely toward a uniform scale, as in the metric system (q.v.):

Uniform scale	Varying scale
10 mills=1 cent	2 pints = 1 quart
10 cents=1 dime	8 quarts = 1 peck
10 dimes=1 dollar	4 pecks=1 bushel

III. The Fundamental Operations.—These are now commonly considered as four in number, although formerly as many as nine *species, atti,* or *passioni,* as they were called, were given. They sometimes included doubling (*duplicatio*), because a common method of multiplication was by successive duplications. They also included halving (*mediatio*), this operation being often used in effecting a division. The Rule of Three, Evolution, and Progressions were also

commonly included. The fundamental operations may more scientifically be classified as follows, each direct process having two inverses:

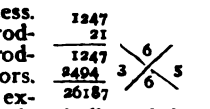
Direct		Inverse	
Addition:	$2+3=5$.	Subtraction:	$5-2=3$. $5-3=2$.
Multiplication:	$2\times\$3=\$6$.	Division:	$\$6\div 2=\$3$. $\$6\div\$3=2$.
Involution:	$2^3=8$.	Evolution:	$2=\sqrt[3]{8}$.
		Logarithms:	$3=\log_2 8$.

Of these the primitive one is addition, multiplication by a positive integer arising when the addenda are equals, and involution to a positive integral power arising from multiplication when the factors are equal. Arbitrarily, elementary arithmetic has usually excluded evolution beyond the cube root, and logarithms. It is now tending to relegate cube root to algebra on account of its difficulty and lack of applications. The exclusion of logarithms (q.v.) is due to their relatively late invention, since, if the theory of their computation is excluded, the subject is simple of presentation and valuable in application.

From the primary operations with natural numbers have been derived operations, designated by the same names and subject to the same laws, involving the artificial numbers. For example, $2\times\$3=\$6$ means that \$3 is taken twice as an addendum, thus: \$3+\$3. But $\frac{2}{3}\times\frac{4}{7}$ cannot mean that $\frac{4}{7}$ is taken as an addend $\frac{2}{3}$ of a time. It means that $\frac{2}{3}$ of $\frac{4}{7}$ is taken, or that $\frac{1}{3}$ of $\frac{4}{7}$ is taken 2 times. It is, however, convenient to broaden the definitions so as to use the same phraseology and symbols as in the case of positive integers. Similar considerations fix a meaning for $-2\times-3=+6$, $\sqrt{2}\times\sqrt{3}=\sqrt{6}$, and $\sqrt{-2}\times\sqrt{-3}=-\sqrt{6}$. For the justification of these usages, see ALGEBRA, DEFINITIONS and FUNDAMENTAL CONCEPT. In certain cases an operation is so difficult that it is more convenient to substitute for it another which gives the same result. This is seen in the case of the division of fractions, where to divide $\frac{2}{5}$ by $\frac{3}{7}$ it is easier to multiply $\frac{2}{5}$ by $\frac{7}{3}$ than to reduce to a common denominator as was formerly done, and then divide, thus: $\frac{2}{5}\div\frac{7}{3}=\frac{2}{5}\div\frac{21}{5}=\frac{2}{21}$.

Of the four common operations, addition is the simplest of comprehension, although not in actual work. In fractions it is usually easier to multiply than to add, as in the case of $\frac{3}{7}\times 1\frac{1}{27}$ compared with $\frac{3}{7}+1\frac{1}{27}$. With integers, both addition and multiplication require the learning of 45 combinations of numbers ($1+2$, $1+3$, ... 1×2, 1×3 ....), and the mere memorizing of these facts is as easy in one operation as the other. Subtraction does not require memorizing a table, since it is merely the inverse of addition, and if taught by the "making change" method it uses the addition table, as division uses that of multiplication.

IV. Checks.— An important consideration in all computations is the checking of the work, to be reasonably sure that no error enters. Checks should be applied at every opportunity so that an error may be discovered as soon as it is made, and not vitiate the further work. The most important check in addition is the repeating of the work in the opposite direction, adding downward if the first addition was upward. The psychological reason for this is that like stimuli tend to produce like reactions, and if an error has been made it is liable to be made again if the numbers are soon met in the same order. Hence the order is reversed to counteract this tendency. In subtraction the best check is that of adding the subtrahend and remainder. If the remainder was obtained by the "Austrian" or "making change" method, this addition should be performed in the opposite direction as in the check for addition. The best check for multiplication and division is that of "casting out nines." This ancient Oriental method was of especial value when the sandboard form of the abacus (q.v.) was used, since the numbers were so frequently erased as to render a general review of the work impossible. This check has gone out of use in American schools, but it is so simple and valuable that it will probably be revived. The check depends upon two propositions: (1) The excess of 9's in a number (that is, the remainder arising from dividing a number by 9) is the same as the excess in the sum of the digits. In the case of 1247 the sum of the digits is 14, and this divided by 9 gives a remainder of 5. It is customary to cast out the 9's as the digits are added, thus: $7+4=11$; cast out 9 and 2 is left; $2+2+1=5$, the excess. (2) The excess of 9's in the product equals the excess in the product of the excesses of the factors. In the case here given, the excesses in the factors are 5 and 3, indicated in the right and left angles of the cross. The excess in their product (15) is 6, indicated in the upper angle. The excess in the product, 26187 is 6, indicated in the lower angle. The upper and lower numbers in the cross are the same, showing that the result is probably correct. In division, the excess of 9's in the dividend equals the excess in the product of the excesses of the divisor and the quotient, plus that in the remainder. Of course, the check of 9's fails to detect an error involving a multiple of 9. There is a somewhat similar check by casting out 11's requiring slightly longer time, but in some respects more liable to detect errors.



V. Short Processes.— There are numerous short processes of performing operations, or rather of securing results by substituting simpler operations than those to be performed. Thus to multiply by $12\frac{1}{2}$ it is often easier to annex two zeros (or move the decimal point two places to the right) and divide by 8. In the same way it is easier to multiply by 100 and divide by 4 than to multiply by 25. Such processes depend upon simple number relations of the following kind: $12\frac{1}{2}=\frac{100}{8}$, $25=\frac{100}{4}$, $33\frac{1}{3}=\frac{100}{3}$, $125=\frac{1000}{8}$, $75\%=\frac{3}{4}$, $125\%=1\frac{1}{4}$, $66\frac{2}{3}\%=\frac{2}{3}$. The publication of extensive tables and the perfecting of calculating machines (q.v.) have rendered obsolete most of the short processes involving other kinds of multipliers and divisors.

VI. Compound Numbers.— The four fundamental processes with compound numbers were formerly considered of much importance, since before the introduction of decimal fractions most tables of denominate numbers were on a varying scale. Within a century, however, the metric system (q.v.) and various monetary tables have so decimalized denominate numbers as to take from compound numbers most of their former importance. The only case in which several denominations are commonly used in writing a number to-day is that of English

money. In most countries the whole subject is obsolete. The United States still uses the British system except in the monetary table, but it has greatly simplified it, rarely using more than two denominations in the same number. Indeed, within a single generation the metric system has come to be used exclusively in this country in scientific laboratories, and the efforts now being made to secure a large foreign trade will make the system more and more known in commercial and industrial affairs.

VII. Methods of Solving Problems.— There are five general methods of attacking an applied problem, as follows:

(1) We may study typical problems and thus acquire the habit of solving others of the same nature. This is the oldest method, and was practically the only one in use before the 17th century. At present it is coming into renewed prominence in American schools, the type problem being attended (as was not formerly the case) by a large number of exercises.

(2) We may commit to memory rules for all general classes of problems liable to be met. Historically, this is the second method of attack, and it characterizes the American textbooks until nearly the close of the 19th century. The rules were usually inductively inferred from type problems, and pupils committed them to memory. Since in practical life we never depend upon a verbatim rule, this method is rapidly becoming obsolete. In mediæval times there was much effort expended in searching for a general rule that would solve all arithmetical problems. Hence arose the Rule of Three (see ARITHMETIC, HISTORY OF), the Rule of False Position, and other rules of less importance, all of which lost their chief value when algebraic symbolism was invented. Of these general rules only the Rule of Three has survived, being now recognized in the form of proportion.

(3) We may learn formulas instead of rules. This method was received with some favor for a time, but it has been discarded as a general plan. It has all of the defects of the method of rules, with the added difficulty of an unnecessarily confusing algebraic symbolism.

(4) We may analyze each problem as it arises, simply applying common sense to the solution. When problems are, as they always should be, properly graded to the understanding of the pupils, this plan is better than any of the preceding ones. It establishes a habit of independence and of confidence that is wholly wanting in the older methods.

(5) We may bring to the aid of analysis the representation of the unknown quantity by the familiar algebraic symbol x. This materially simplifies the analysis, and most writers on arithmetic at the present time advocate the plan. The concept of the linear equation with one unknown quantity is a very simple one, and it greatly clarifies the analysis in many cases.

VIII. Nature of the Problems in Arithmetic.— The interests of the ancient and mediæval philosophers were not at all commercial. These men were attracted rather by considerations of the properties of numbers and by puzzles which were imagined to sharpen the wit. The rise of commerce in the later Middle Ages and at the time of the Renaissance, brought into the science a large number of applied problems representing actual business conditions. Principles of conservatism have tended to keep these ancient problems from generation to generation, strengthened by the feeling that mental discipline was as well secured from an obsolete as from a modern problem. It is therefore only recently that the question has arisen: What should be the nature of the problems set for children studying arithmetic? In answer to this question teachers seem to be tending to observe the following principles:

(1) A problem that pretends to set forth a business custom should state the real business conditions of the present. This excludes obsolete business problems, it being the opinion that better mental discipline can be secured from a question relating to genuine commercial matters of the present, than from one relating solely to forgotten customs.

(2) Problems should appeal to the interests and understanding of the children in their respective school years. Arithmetic was formerly taught only to boys who could read and write and who were preparing for business. When the subject found its way into the earlier school years it carried many difficult problems of business down to immature minds. The modern tendency is to replace such problems by others that relate to children's interests. Thus in the primary grades there should be the study of home purchases, of the application of number to the large interests of the country, especially such as appeal to a child's love of nature and of the heroic, and such as relate to the sources of food and clothing. Later, the problems should refer to the more detailed features of the national and world life, to the great industries, trades and transportation facilities. Finally they should relate to the details of the industrial and commercial life, thus preparing both the boy and the girl for earning a livelihood. In all this there should be an effort to make arithmetic interesting, since when the interest of the pupil is secured the work is prosecuted with more zeal and is attended with better and more permanent results.

(3) In the effort to modernize the problems care must be taken to avoid the extreme of withdrawing from arithmetic all topics involving effort, thus making the subject insipid from its very lack of fibre.

IX. Sequence of Topics.— Formerly arithmetic was taught from a single book, each important topic being met but once. Then came the two-book series, the second book covering the ground of the first, but with more difficult examples, thus forming a spiral of two revolutions. In this way there arose the so-called Spiral Method of treatment, which certain devotees have carried to the extreme of returning to each topic every few days. Between the topical method and the radical spiral method there has been much strife. Advocates of the latter said that the former encouraged forgetfulness through lack of review, while advocates of the former said that the latter gave the pupil no feeling of mastery of any subject. The result has been a compromise, seen in all modern American courses. Such important topics as percentage are treated several times, with progressive difficulty, applications like simple interest offering new features on each succeeding occasion. On the other hand, such

relatively unimportant chapters as that on longitude and time (semi-geographical) are met but once. In the same spirit, the fundamental operations with integers, decimal fractions, and those common fractions often met in business, are frequently reviewed, while compound numbers and fractions involving unusual numerators and denominators are less emphasized. The technicalities of business, including the study of investments, insurance, banking and exchange, are reserved until the last years of the grammar school, when a child beginning to look forward to being self-supporting is prepared to understand them.

X. Methods.— Various methods have been suggested for presenting arithmetic to children, especially in the primary grades. The serious consideration of this phase of the subject began toward the close of the 18th century, particularly in Germany and Switzerland. With it are connected such names as Trapp, von Busse, Kranckes, Pestalozzi, Tillich, Grube, Tanck, Knilling and Kaselitz. Each of these writers stood for some principle which he carried to such an extreme as to render the method generally unusable. Pestalozzi, for example, did great good in his judicious use of objective illustration, but he went to an unwarranted extreme in his emphasis of the unit and in his devotion to abstract work. Tillich suggested a valuable set of number blocks, but his followers went to the extreme of eliminating all other material. Grube wrote a condensed manual for teachers, and systematically treated numbers in concentric circles of progressive difficulty, but he went to several extremes that made the system so absurd that it is now nearly forgotten. On the other hand, every prominent writer of this class has usually suggested some slight improvement which has gradually worked its way into the schools. It has been the universal experience that no advocate of a single method has been able to impress this method on any considerable number of followers. The best teacher has been the one who, being interested in the subject, has imparted that interest to the pupils, who has not been limited to any one set of objects or to any peculiar device, who has made arithmetic modern in its applications, and who has followed the best curricula of the day.

XI. Time Required for the Subject in the Schools.— There has been a gradual diminution in the time allowed to arithmetic in American schools for a number of years past, on account of the demands of more modern studies for a place in the curriculum. As a result there has been decreased attention to the subject, there is less ability on the part of pupils to grapple with problems, and the question has arisen as to the amount of time necessary to secure a reasonable facility in the arithmetical processes. Although the textbooks and the teaching have both improved, the curtailment of time and the scattering of the pupils' attention over more subjects have left the results far from satisfactory. It has even been urged that arithmetic be not taught before the third or after the seventh school year, thus allowing five instead of eight years to the subject. But although it is true that the necessary parts of arithmetic can be covered in five school years, it is equally true that the child has as much delight in his work with numbers in his first school year as he has in the other subjects studied, and quite as much need for this work. It is also true that the number facts are more easily impressed on the memory if the work is begun, as Pestalozzi advised, when a child first enters school. It is therefore better to allow arithmetic to extend throughout the elementary grades, combining with it, if the class is well advanced, some constructive geometry and the first steps in algebra in the eighth school year.

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ARITHMETIC, History of. Among the ancients there were two distinct sciences now called by the name arithmetic. One had to do with the science of numbers and the other with the art of computation. The former was called, by the Greeks, *arithmetic* (*ἀριθμετική*), and the latter *logistic* (*λογιστική*). Logistic was taught to boys going into trade and among the most ancient peoples it probably involved the use of the abacus (q.v.) and commercial rules relating to rents, loans, exchange and the settlement of accounts. The nature of the problems being simple, and abacus computation depending largely upon manual training, the instruction in this art seems to have been entirely oral. On this account no ancient work upon the subject is extant, and our knowledge concerning it is derived from such sources as the Babylonian cylinders, early Cretan remains, certain fragments of Egyptian papyri and the occasional references of literary writers. In the Middle Ages the instruction offered by the Church schools was so meagre from the commercial standpoint that arithmetic schools (*Rechenschulen*) were established, and in these logistic (*Rechnung*) was taught. A number of manuscripts of the 13th, 14th and 15th centuries are extant showing the nature of the problems then considered necessary, but extant treatises on counter reckoning (see ABACUS) are mostly confined to the first century of printing. Not a few of the problems of importance at that time still survive in the arithmetics of to-day, although substantially obsolete from the commercial standpoint.

The Greek *arithmetic*, or theory of numbers, begins with Pythagoras (q.v.), about 530 B.C., who taught their mystic properties, and to whose school is probably due most of their ancient classification. The fundamental division of numbers seems to have been into odd (*ἄρτιοι*) and even (*περιττοί*), the former being masculine, divine, lucky, and the latter feminine, earthly, unlucky. The expression "There is luck in odd numbers," appears in Virgil as "*Numero Deus impare gaudet*," and probably goes back to the Pythagoreans. The odd numbers were, on account of their geometric representations, also called gnomons (*γνώμονες*), and it was well known that the sum of the first *n* of these gnomons, including

1 (which was not generally considered a number until the 17th century), was a square τετράγωνος). The side (πλευρά) of the square was called by the later writers *radix* (*root*, whence *radical*). It is therefore evident that the Greeks looked upon arithmetic from the standpoint of geometry. Following out this plan, they studied triangular numbers, formed by arranging dots in the form of a triangle, as in the case of 3 (∴), 6, 10, etc., and also pentagonal and other *figurate numbers*, solid as well as plane. Many other classifications were suggested by the Greeks, some of which have remained in our school books until quite recently. Such, for example, included *perfect numbers* (τέλειοι), which are equal to the sum of all possible factors, including 1 (for example, $28 = 1 + 2 + 4 + 7 + 14$), and *amicable numbers* (φίλιοι), each of which equals the sum of the possible factors of the other, including 1 (for example, 220 and 284). Euclid (q.v.) (c. 300 B.C.) emphasized the ancient arithmetic in his books II, V, VII, VIII, IX and X, although II, V and X are nominally geometric. Soon after, Eratosthenes (q.v.) (c. 225 B.C) made a particular study of primes, and invented a "sieve" (κόσκινον), which bears his name, for the purpose of sifting out the composite numbers. In the next century Hypsicles (c. 180 B.C.) made a more extensive study of progressions than had before been attempted. It is, however, to Nicomachus (q.v.) (c. 100 A.D.) that we owe the first great treatise on arithmetic (Εἰσαγωγὴ ἀριθμητική), a work which sought to do for that subject what Euclid had done for geometry, and which actually succeeded in turning the attention of the later Greeks from the science of form to the science of number. The next great arithmetician was Diophantus, who wrote probably in the 4th century. His arithmetic (Ἀριθμητικά) professes to be in 13 books, but only six (seven in one Vatican MS.) are extant. In the main, however, this treatise relates rather to algebra.

The greatest difficulty of the ancient arithmeticians and calculators lay in the treatment of fractions. This is seen in the oldest mathematical treatise of any note as yet deciphered, a papyrus copied by one Ahmes, an Egyptian scribe of c. 1700 B.C., from an earlier MS., probably dating from c. 2300 B.C. Here all of the fractions, save ⅔, have 1 as a numerator. For example, $\frac{4}{43}$ was written, in hieratic characters, as $\frac{1}{43}$ $\frac{1}{301}$ $\frac{1}{602}$, this meaning that the sum of these unit fractions equals $\frac{4}{43}$. The Akhmin papyrus, written more than 3,000 years after the original of the Ahmes work, gives the same treatment of fractions, thus testifying to the difficulty of the subject. While the Greeks and Romans simplified the subject and improved the symbolism, it is to the Hindus and Arabs that we are indebted for our present convenient forms.

The Romans contributed but little to the theory of numbers, although their mercantile spirit doubtless led them to improve the abacus. Their only writer of prominence was Boëthius (q.v.), who, early in the 6th century, did much to make the ideas of Nicomachus known in western Europe, and whose treatise was the standard in the Church schools for many centuries.

Of the early Hindu arithmeticians but little is known. There are, however, several works extant that set forth the theory and practice of numbers in the period following the introduction of the zero and the consequent perfecting of the system of place value. (See NUMERALS). It is in this period that the foundations for our common arithmetical operations were laid. From the Hindus the Arabs of the Bagdad school (c. 800 A.D.) drew their inspiration. The earliest Arab writer to make extensive use of the Hindu numerals, in a textbook on arithmetic, was Al Khowarazmi (q.v.). So prominent was his treatise that his name became a synonym for the Hindu arithmetic, even as Euclid became synonymous with geometry. The early Latin translations, one of which was made by Adelard of Bath (q.v.) (c. 1120 A.D.), went by such names as 'Liber Algoritmi' ('The Book of Al Khowarazmi'), whence comes our word *algorism* (*algorithm*, in Chaucer *augrim*), a name for a long time used to mean the arithmetic of the Hindu numerals.

The Arab arithmetic became known in Christian Europe chiefly through the 'Liber abaci' of Leonardo Fibonacci of Pisa (q.v.), in 1202. In the 13th century the great rivalry of trade brought into prominence the commercial aspect of the subject, and from this time on the theoretical treatment as exemplified in the works of Nicomachus and Boëthius gradually lost ground.

The first printed arithmetic appeared anonymously at Treviso, in Italy, in 1478. In Germany the first one to appear from the press was published at Bamberg in 1482. The commercial supremacy of Italy and Germany was such that their works for the next century were largely mercantile, the arithmetic of the Boëthian type being published more often in Paris than elsewhere. It was quite late in the 16th century before France produced many commercial arithmetics, and when these did appear the tendency to unite some of the features of the Boëthian arithmetic gave their books considerable influence. The first arithmetic to be printed in England was the prolix theoretical work of Bishop Tonstall (1522), and it was not until about the middle of the century that Recorde (q.v.) began to publish his popular commercial textbook. Owing to the great mercantile activity of Holland between 1575 and 1650, a large number of arithmetics appeared in that country early in the 17th century, and materially influenced the textbooks of England. To this creative period of arithmetic is due a large amount of matter once of importance but now quite obsolete. An extended treatment of compound numbers and of certain forms of exchange was more necessary then than now; barter was of great importance; partnership accounts were settled by a process quite different from that of to-day; alligation was of real use in the numerous mints then existing; proportion (usually in the form of the Rule of Three, *Regula de tre*, *Regeldetri*) was much more often used in practice than at present. The first arithmetic to be printed in America was Hodder's popular English work, which was republished in Boston in 1719.

The symbolism of arithmetic amounted to very little before the 19th century, when the symbols invented for algebra (q.v.) between 1550 and 1650 were rather injudiciously adopted in elementary arithmetic. The greatest advance since 1600 has been the invention of decimal fractions, a feature which revolution-

ized business arithmetic, making percentage simple and common, and rendering tables practicable.

The operations of arithmetic were formerly performed on some kind of abacus (q.v.) At the time of the invention of printing our present forms of addition and subtraction were quite common. There were, however, several methods of multiplication, although our present form was already in favor. The present method of division did not come into general use until the 17th century, although it appears in rare cases in the 15th.

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ARIUS, an Alexandrian theologian and controversialist, the father of Arianism (q.v.): b. in Libya, north Africa, about 256 A.D.; d. Constantinople, 336. He was educated under Lucien at Antioch and later went to Alexandria, where several years afterward he so severely suffered from the Diocletian persecution. He was ordained deacon by Peter, Bishop of Alexandria, whom he had joined in the Meletian Schism; then joined the schismatics and in consequence was excommunicated; later repented and was restored to his former good standing; and about 311 was advanced to the priesthood and placed in charge of a suburban church.

In 318 Arius became involved in a controversy with Alexander, Bishop of Alexandria, about the doctrine of the person of Christ, the latter contending that there was only a single essence, whereas Arius denied that Christ was unoriginated being, but was created out of nothing and therefore *in essence* must be different from the Father. He also affirmed that though Christ were the Son of God, he was not so in and of himself, but only so by the *grace* of God the Father; and that, were he in the truest sense a son, he must have come *after* the Father, therefore the time obviously was when he was not, and hence he was a *finite* being. These doctrines, emanating from a man of so great personal popularity and so highly regarded as a presbyter, though they contained nothing essentially new or original in thought and had been more or less prevalent in the Church for three or four generations, soon gained many adherents. Alexander, fearing the spread of the so-called heresy, in 321 called a council of 100 Egyptian and Libyan bishops, and Arius was immediately excommunicated.

Arius then retired to Nicomedia, under the protection of one of his supporters, Eusebius, Bishop of Nicomedia, who, notwithstanding Alexander's exhortations to exclude the heretic, absolved him, and at a local synod in 323 brought about an endorsement of his opinions and actions. The dispute soon attracted the attention of Constantine, who had become emperor in 323. Thinking to avert further controversy he sent his ecclesiastical adviser, Hosius, Bishop of Cordova, to Alexandria, in an effort to arrange, through concessions by both parties, a doctrine to which both would subscribe. This attempt at reconciliation being barren of results, Constantine in 325 called a general council of all the bishops of the Church at Nicæa, in Bithynia, Asia Minor. This was the first œcumenical council and the attendance has been variously estimated. Gibbon places the number of bishops at 318; Eusebius at 250; and others at 300 and 320. About 2,000 other representatives of the Church throughout the East also attended the sessions. The Eastern bishops attended in person; the Western Church was represented by seven delegates, the most important of whom was Hosius, Bishop of Cordova, who presided over the sittings, which continued for about two months.

The conference developed into three distinct parties: (1) The strict Arians, led by Arius himself, who claimed that Christ was a pre-existent, divine, finite being and was different *in essence* (*heteroousios*) from the Father; that he was created by the Father out of nothing, but that he himself was the creator of the world and the incarnate Saviour; (2) The semi-Arians, who maintained that Christ was not *identical in essence*, but was of *similar essence* (*homoiousios*) with the Father; and (3) the Athanasians, led by Athanasius (q.v.), a young deacon of Alexandria, as Alexander's personal representative, who contended that the Son was *identical in essence* (*homoousios*). There were two other parties present, those of Eusebius of Nicomedia, and those of Eusebius of Cæsarea, the latter of which formulated a compromise creed, which was not, however, adopted. These two favored Arius and were classed as heretical, but later both signed the creed as adopted. After much discussion of the doctrines of Arius, his creed was torn in pieces and he himself ejected from the council, and the Athanasians succeeded, with the help of Constantine and the Western bishops, in securing the adoption of a creed to which the Arians would not subscribe. The council declared that it was and always had been the teaching of the Church Apostolic, in conformity with the apostolic tradition in all the churches, that Jesus Christ was "consubstantial"— *in essence* the same — with the Father. Thus in the Nicene Creed will be found the words *consubstantialis patri*, an exact rendering of the Athanasian claim *homoousios*. The creed reads: "We believe in the God, the Father Almighty, maker of all things visible and invisible; and in one Lord Jesus Christ the only-begotten Son of God, begotten of the Father (that is of the *essence* of the Father) before all worlds God of God, Light of Light, Very God of Very God, begotten, not made, being one substance (*homoousios*) with the Father," etc. This was somewhat abridged in the Nicæno-Constantinopolitan creed of 381 A.D. In consequence of refusing to sign the creed as adopted, Arius and two of his companions were excommunicated and banished to Illyria.

Soon after the Nicene Council had concluded its work, the semi-Arians began to assail the creed, and during the next few years Arius himself carried on propaganda work against it, corresponding with several prominent bishops, with the result that in 331, through the influence of Eusebius and Constantia, sister of the Emperor, Arius was recalled to court. Constantine, upon being convinced that the creeds of Arius and Athanasius were substantially alike, ordered Athanasius to receive Arius into the communion of the Church. Athanasius refused, was deposed by a synod of bishops at Tyre in 335, and sent to Gaul. A second synod, convened at Jerusalem in the same year, remitted the decree of excommunication against Arius and his followers, but even this did not establish him in his former exalted position nor cause his doctrines to be accepted by the followers of Athanasius. Disappointed and disheartened, Arius in 336 returned to Constantinople, where, again convincing Constantine of his orthodoxy, orders were issued to Alexander, Bishop of Constantinople, to administer the holy communion to him the following Sunday, but on the Saturday preceding his expected restoration, he was suddenly taken ill and died. See ARIANISM; CHRISTOLOGY; COUNCIL; CREEDS; EUSEBIUS OF NICOMEDIA; EUSEBIUS OF CÆSAREA; INCARNATION; NICÆA, COUNCIL OF; NICENE CREED.

ARIZONA (from the former Papago locality of *Arizonac,* or *Arizonaca,* probably meaning "place of small springs," a few miles from the present Nogales, where some celebrated nuggets of silver were discovered in 1736–41. It has no connection with "arid zone," etc.). A State of the United States (Western or Pacific group), bounded by Utah and Nevada on the north, New Mexico on the east, Mexico on the south, Nevada, California and Lower California on the west. It extends from lat. 31° 20′ to 37° N. and from long. 109° 2′ to 114° 35′ W. Land area, 113,810 square miles (72,838,400 acres), thus ranking fifth in size among the States. Pop. (1910) 204,354, (1917, est.) 263,788; males, 58.4 per cent. The capital is Phoenix.

Topography and Geology.— Topographically Arizona presents two great divisions: a plateau region in the north, made up of approximately horizontal strata; and the mountainous region in the south, consisting of uplifted strata plicated and folded with mineral rocks and intrusive veins. These mountain ranges are numerous and have a general northwest and southeast trend, with intermediate broad valleys often 20 to 30 miles wide. The chief mountain masses are the Castle Dome, Big Horn, Eagletail, Chocolate, Dome Rock, Palomas, Harquahala and Harcuvar in the southwest; the Aquarius and Colorado in the west; the great plateaus rising in what are sometimes called the Northside Mountains in the northwest; the San Francisco and Black in the north central; the Carrizo, Lukachukai and Tunicha in the northeast; the Zuñi, White, Mogollon and Apache in the east; the Gila, Peloncillo, Pinaleño, Dragoon, Galiuro, Santa Catalina, Huachuca and Baboquivari in the southeast and south. The isolated volcanic San Francisco Mountains above Flagstaff are the highest of all, rising in their greatest height to 12,794 feet, and in Humphrey Peak to 12,562 feet. The other important peaks in the State are Thomas, 11,496 feet; Escudillo, 10,691; Graham, 10,516; Ord, 10,266; and Greens, 10,115, while many others exceed 5,000 feet. To the south the surface falls sharply to low ridges, mostly volcanic; thence by terraced mesas to a great desert plain little above sea-level, cut by gullied stream-beds drawing the occasional rainfall to the broad and shallow Gila. The great northern plateau, or series of plateaus, range in altitude from 5,000 to 7,500 feet; rising from them are numerous mountain spurs, buttes and the cones of extinct volcanoes, while the Colorado River has cut through 6,000 feet of strata, exposing formations down to Carboniferous and Tertiary marine strata, underlying Tertiary lake sediments and later alluvium; indeed it has been said that every period of the world's history since the dawn of life is represented in the geology of Arizona. The surface of the land as it lies was formed by a huge Eocene uplift, the water action afterward cutting the gorges and shaping the mesas and buttes; another took place in the Miocene, with eruptive volcanoes. Near Holbrook, Navajo County, is a wonderful chalcedony forest (see FOREST, PETRIFIED), with prostrate trunks four feet thick cracked into exquisitely colored blocks. Everywhere a feature of the landscape in the northern section is the great isolated mesas of sandstone with scarped and pinnacled sides, often more than 1,000 feet in sheer height. Most of the stream courses are dry save in the rainy season, and even then their flow is sometimes swallowed by the sands. The one considerable river is the Colorado (q.v.) which flows generally southwest from Utah for 400 miles through the famous Grand Cañon of Arizona (q.v.), one of the wonders of the world, then turning south, forming the western boundary of the State until shortly before it reaches the Gulf of California. Its chief affluent in the State is the Gila, which flows entirely across its southern portion; other tributaries are the Virgin, which crosses the extreme northwest corner; the Colorado Chiquito or Little Colorado in the north, and Bill Williams fork in the west. Important tributaries of the Gila are the Salado, or Salt, and the Verde from the north and the San Pedro from the south.

Climate.— Arizona is entirely within the arid region, but owing to the difference in altitude of the northern and southern portions there is a wide range in temperature, as likewise in precipitation between the two sections. The average annual precipitation at Flagstaff since 1850 averaged 24.65 inches, that of Yuma 2.84 inches; while the mean temperature is 45° in the north and 69° in the south. The sandy plains of the southwestern part are the hottest region north of the Isthmus of Panama, 120° in the shade being frequent in summer; but even in this lower area, owing to the dryness of the atmosphere, the heat is not very oppressive in summer, while the winter climate is usually delightful. Heavy snows occur in the mountainous country of the north and sharp frosts are frequent even in the Salt and Gila valleys; but nowhere are the mountains perpetually snow-capped. In recent years Arizona has become a popular resort for those suffering from pulmonary tuberculosis and catarrhal ailments, but notwithstanding the deaths of

those who settle in Arizona when seriously afflicted with tuberculosis, the total death rate in 1914 was only 14.98. In 1913, out of 779 deaths from this cause, 538 cases had their origin outside the State.

Minerals and Mines.— Arizona is rich in minerals and its mining industry is of prime importance. In 1915 it was first among the States in copper production, 459,972,295 pounds having been mined; it was fifth in silver (5,649,020 fine ounces, commercial value $2,-864,053), and fifth also in gold (201,531 fine ounces, commercial value $4,166,025). Of lead, 21,738,969 pounds were produced, valued at $1,-021,732, and of zinc (spelter) 8,428,526 pounds. There are also deposits of coal (as yet but little worked), fluorspar, mica, molybdenum, nickel ores, limestone, marble, granite, sandstone in limitless quantities, chalcedony, tungsten, turquoise, vanadium, garnet (pyrope) and other minerals, and there are numerous hot and mineral springs. In 1915 Arizona ranked seventh in mineral products, the value being $91,541,-403.

Soil, Agriculture, Forestry.— Of the 72,-838,400 acres in Arizona, 1,935,327 acres were cultivated in 1900 and 1,246,613 acres in 1910, a decrease of 35.6 per cent; farm property, however, increased in value from $29,993,847 to $75,123,970 during the decade, while the number of farms increased from 4,985 to 8,203, of which latter number 7,038 farms were free from mortgage. Only 1.7 per cent of the total land area was in farms in 1910. The valley lands are marvelously fertile, experiment demonstrating that in the southern part, under favorable conditions, the yield per acre is 2,150 pounds for wheat, 4,000 to 5,000 pounds for potatoes, 12,300 pounds for tomatoes, 5,000 pounds for strawberries, 27,000 pounds for melons and 1,735 pounds for corn. Lack of water has been more or less a hindrance to the development of the agricultural sections, but with the construction of storage reservoirs in recent years by the government, it is estimated that a total of 10,000,000 acres will be reclaimed. In 1910, 320,051 acres were under irrigation. The staple crops are alfalfa, barley, corn, wheat, sugar beets, green vegetables and orchard fruits and grapes. Experiments in the cultivation of Egyptian cotton have proved successful, 6,500 acres having been picked in 1916; and tracts of alkali lands in the south, hitherto believed to be waste, are now being utilized largely by the State for date culture.

The mountains and mesas of the northern part are generally covered with nutritious grasses, forming excellent pasturage for cattle and sheep, while irrigated pastures in the south afford means of fattening for market. In 1910 there were 833,458 cattle, 1,227,864 sheep, 114,609 horses, 5,284 mules, 9,982 asses, 259,-396 goats and 18,512 swine. Fowls were valued at $1,545,966, bees at $104,374, and dairy products at $909,411. The wool production in 1909 was valued at $983,761 and mohair at $63,120. Of the total value of crops in the same year, 46.4 per cent was in hay and forage ($2,553,-228), and 28.6 per cent in cereals ($1,570,853). The value of all crops was $5,496,872, an increase of 122 per cent in 10 years.

The southern plains and parts of the north have a dress of sagebrush, greasewood, yucca, cactus and other desert growths. Cottonwoods line almost every stream. Mesquite, the giant cactus or saguaro, paloverde, ironwood, Jerusalem thorn and other trees are indigenous to the southern plains, and vast mountain areas throughout Arizona are covered with pine, cedar, juniper and other valuable timber. An important lumbering industry has been developed in the vicinity of the San Francisco Mountains, but vast tracts of timber in this and other sections have been set aside by the government in the Kaibab, Cocomino, Dixie, Prescott, Sitgreaves, Tonto, Apache, Coronado, Garcés, Chiricahua and other forest reserves.

Industry, Commerce.— Mining is the chief industry of Arizona and copper the chief metal mined, although considerable gold, silver and lead are also produced. (See above). In manufacturing Arizona holds no important place, ranking 42d among the States, but gaining an increase of 27.5 per cent in value of products in five years. In 1914 it had 321 manufacturing establishments, representing an investment of $40,282,000, a product worth $64,068,000, and wage-earners numbering 6,888, with wages amounting to $6,221,000. In 1909 there were 251 producing mines and quarries, with 16,917 wage-earners and with products valued a $34,-217,651, of which sum $31,614,116 was in copper.

Finance.— The total receipts for the fiscal year 1915 were $2,953,291 and the expenditures $3,127,929. On 30 June 1915 there was an unexpended balance in the State treasury of $579,183, while the gross debt amounted to $3,319,048 ($13.65 per capita). The assessed valuation of all properties amounted to $408,-540,283, the general levy rate being $4.48. The same year the number of National banks was 13 and of State banks 47, with a capitalization of $3,046,452, and total deposits amounting to $30,-093,522.

Railroads.— The railroad mileage in 1916 was 2,404 and was valued for assessment at $93,147,822; of the mileage 69.88 miles, valued at $1,165,200, were exempt from taxation until 1919.

Defense.— In 1915 the national guard of Arizona numbered 883 men; in addition there were 12 civilian rifle clubs with a membership nearly equalling that of the organized militia. The only armory in the State was erected at Tucson in 1915 at a cost of $28,000. In 1913 Arizona's rifle team won 10th place among 45 competitive teams at Camp Perry; and in 1914, at Fort Riley, with matches open to entries from the United States army and western and southwestern States, the Arizona marksmen received first awards in all of the eight matches with the exception of two, establishing a State record.

Education.— Arizona has a good public school system and is energetic in extending its facilities to its children despite the scattered population. Education is compulsory. The school population in 1914 was 53,845; the estimated number of children of school age (5 to 18 years) being 57,491. The value of school real and personal property was $501,852,186; teachers employed, 154 men (average salary, $113.87), 942 women (average salary, $85.59). In teachers' salaries Arizona is exceeded by only six States. Cost of maintenance, 1885, $138,164; in 1914. $2,135,549. There is a State University at Tucson (308 pupils), normal schools at

ARIZONA

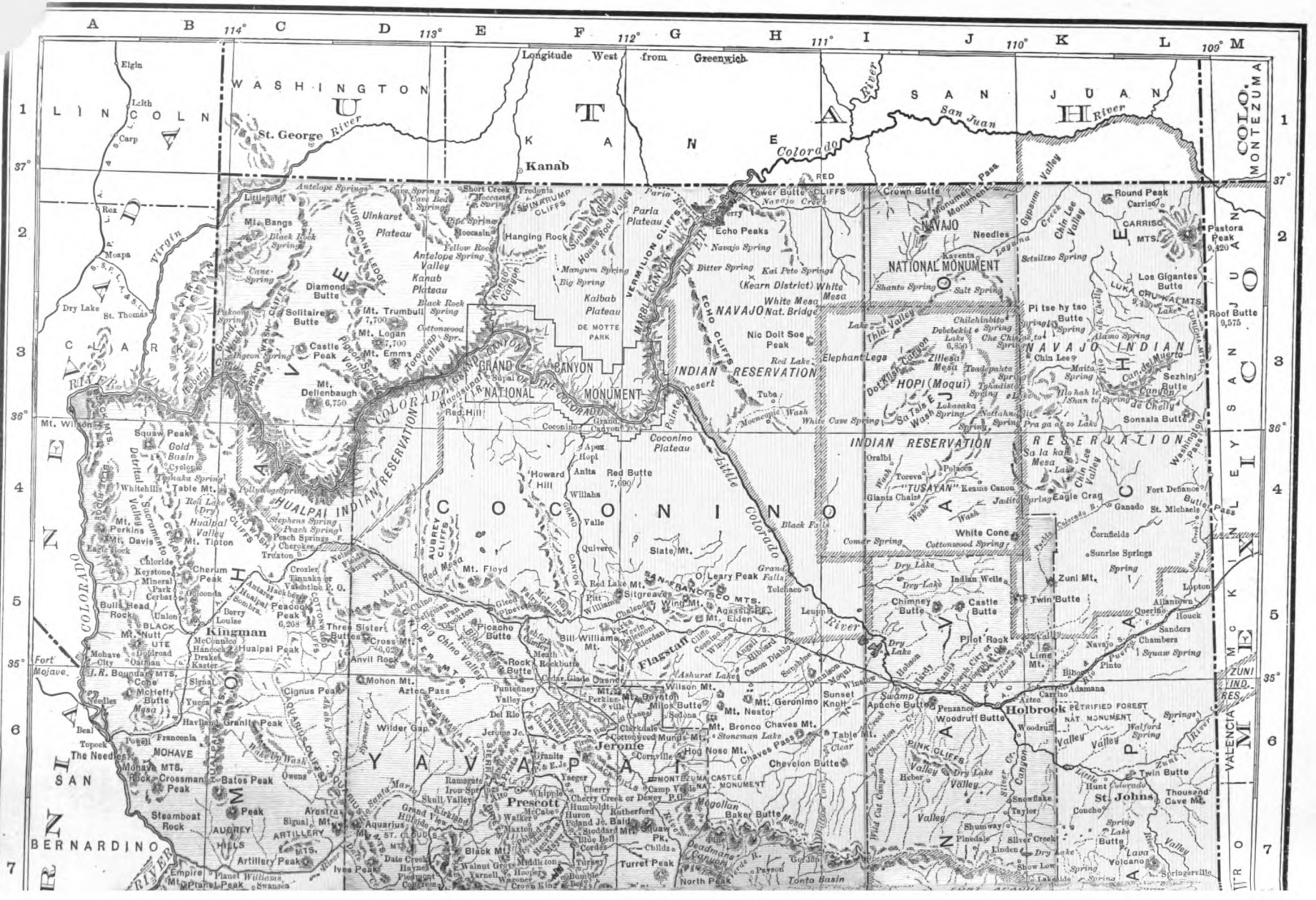
Estimated population, 272,034

COUNTIES

Pop.			Pop.		
9,196	Apache	L 5	3,773	Mohave	C 4
34,591	Cochise	K 12	11,471	Navajo	J 6
8,130	Coconino	F 4	22,818	Pima	G 11
16,348	Gila	J 8	9,045	Pinal	H 10
9,181	Graham	K 10	6,766	Santa Cruz	I 12
14,818	Greenlee	L 9	15,996	Yavapai	F 6
34,488	Maricopa	F 8	7,733	Yuma	B 9

Incorporated Cities and Towns

9,019	Bisbee	K 13	500	Pima	K 10
275	Chloride	B 5	5,092	Prescott	F 7
4,874	Clifton	M 9	929	Safford	K 10
6,437	Douglas	L 13	1,473	Tempe	G 9
1,633	Flagstaff	G 5	904	Thatcher	K 10
807	Florence	H 9	1,582	Tombstone	K 12
7,083	Globe	I 9	16,750	Tucson	I 11
2,393	Jerome	F 6	570	Wickenburg	E 8
1,692	Mesa	G 9	1,267	Williams	F 5
3,514	Nogales	I 13	2,381	Winslow	I 6
18,621	Phœnix	F 8	2,914	Yuma	A 10


Longitude West from Greenwich
114°
113°
112°
111°
110°
109°
37°
36°
35°
WASHINGTON
LINCOLN
CLARK
NEVADA
MOHAVE
YAVAPAI
COCONINO
NAVAJO
APACHE
GILA
GRAHAM
SAN BERNARDINO
UTAH
ARIZONA
COLO.
NEW MEXICO
SAN JUAN
MONTEZUMA
VALENCIA
MCKINLEY
ZUNI IND. RES.
Kanab
St. George River
Colorado River
San Juan River
Virgin River
Little Colorado River
Grand Canyon
GRAND CANYON NATIONAL MONUMENT
HUALPAI INDIAN RESERVATION
HAVASUPAI INDIAN RESERVATION
NAVAJO INDIAN RESERVATION
HOPI (Moqui) INDIAN RESERVATION
NAVAJO NATIONAL MONUMENT
PETRIFIED FOREST NAT. MONUMENT
MONTEZUMA CASTLE NAT. MONUMENT
Hurricane Ledge
Uinkaret Plateau
Kanab Plateau
Parla Plateau
Kaibab Plateau
Vermilion Cliffs
Echo Cliffs
Shinarump Cliffs
Aubrey Cliffs
Coconino Plateau
Painted Desert
Little Colorado
Grand Canyon
Marble Canyon
Kanab Canyon
Havasu Canyon
Cataract Canyon
Diamond Creek
Bill Williams Mt.
Flagstaff
San Francisco Mts.
Mt. Floyd
Red Mesa
Red Butte 7,690
Howard Hill
Anita
Valle
Quivero
Slate Mt.
Sitgreaves
Leupp
Tolchaco
Black Falls
Comer Spring
Cottonwood Spring
White Cone
Cornfields
Sunrise Springs
Indian Wells
Zuni Mt.
Twin Butte
Chimney Butte
Castle Butte
Pilot Rock
Dry Lake
Lupton
Allantown
Chambers
Navajo
Squaw Spring
Pinto
Lime Mt.
Querino
Houck
Sanders
Adamana
Holbrook
Petrified Forest
Woodruff
Woodruff Butte
Penzance
Carrizo
Aztec
Apache Butte
Swamp
Sunset Crossing
Winslow
Moqui
Canon Diablo
Supaine
Ashurst Lake
Mt. Elden
Agassiz Pk.
Wing Mt.
Leroux
Delmonte
Riordan
Cosnino
Wilson
Gillespie
Fort Defiance
St. Michaels
Ganado
Eagle Crag
Jadito
Toreva
Polacca
Oraibi
Keams Canon
"TUSAYAN"
Giants Chair
Sonsala Butte
Sa la ka Mesa
Lukachukai Mts.
Carrizo Mts.
Round Peak
Pastora Peak 9,420
Roof Butte 9,575
Los Gigantes Butte
Needles
Kayenta
Setsiltso Spring
Shanto Spring
Salt Spring
Gypsum Creek
Chin Lee Valley
Laguna
Monument Pass
Monument Valley
Crown Butte
Tower Butte
Navajo Creek
Echo Peaks
Navajo Spring
Bitter Spring
Kai Peto Springs
(Kearn District)
White Mesa
White Mesa Nat. Bridge
Nic Dolt Soe Peak
Red Lake
Elephant Legs
Tuba
Moencopie Wash
White Cave Spring
Pi tse hy tso Butte
Chilchinbito
Debeckid Lake
Che Chin Spring
Alamo Spring
Zillesai Mesa
Dot Kish Canyon
Tsodzisa Spring
Lokanaka Spring
Nutahana Spring
Pra ga at zo Lake
Sa Tsle Wash
Hlo hah le Shan to Spring
Chin Lee
Maita Spring
Tsodzisa Spring
Sezhini Butte
Canon de Chelly
Canon de Muerto
Washington Pass
Chin Lee Valley
Lake
Thin Valley
Dry Lake
Hibbard
Heber
Valley
Snowflake
Taylor
Shumway
Pinedale
Silver Creek
Linden
Show Low
Lakeside
Spring Valley
Pinetop
Lake
Butte
Lava
Volcano
Springerville
Twin Butte
Hunt
Colorado
Thousand Cave Mt.
St. Johns
Concho
Little Colorado
Silver Creek Canyon
Wild Cat Canyon
Chevelon Canyon
Chevelon Butte
Table Mt.
Clear
Hog Nose Mt.
Stoneman Lake
Chaves Pass
Mt. Bronco Chaves Mt.
Mt. Nestor
Mt. Geronimo
Wilson Mt.
Boynton
Milos Butte
Sedona
Cornville
Cottonwood
Munds Mt.
Jerome
Jerome Jc.
Clarkdale
Verde
Verde R.
Tonto Basin
Payson
Rye
Gordon
Childs
Turret Peak
North Peak
Deadman Canyon
Magellan
Baker Butte
Mesa
Squaw Pk.
Blue Bell
Cordes
Stoddard
Foland
Jo. Baldy
Rutherford
Cherry Creek or Dewey P.O.
Camp Verde
Yeager
Cherry
Humboldt
Huron
Walker
McCabe
Prescott
Whipple
Skull Valley
Iron Springs
Ramsgate
Kirkland
Grand View
Hillside
Aquarius
Arastra
Signal Mt.
Aubrey Hills
Artillery Mts.
Artillery Peak
Steamboat Rock
Steamboat Peak
Crossman Peak
Bates Peak
Mohave Mts.
Mohave
Oatman
Boundary Mts.
Fort Mojave
Yucca
Yucca
Needles
Topock
Beal
Parker
Franconia
Hayland
Granite Peak
Cignus Peak
McHeffy Butte
Mesa
Mohon Mt.
Aztec Pass
Wilder Gap
Granite Mts.
Granite
Pumpkin Valley
Del Rio
Rockbutte
Picacho Butte
Bill Williams Mt.
Cedar Glade
Oasis
Rock Butte
Cross Mt. 6,020
Anvil Rock
Three Sister Buttes
Huaipai Peacock Peak 6,208
Huaipai Peak
Kingman
Hackberry
Antares
Berry
Louise
Drake
Kaster
McCompico
Hancock
Union
Bull's Head Rock
Black Mt.
Nutt
Ute
Oatman
Chloride
Keystone
Mineral Park
Cerbat
Oloonda
Cherum Peak
Mt. Perkins
Mt. Davis
Eagle Rock
Mt. Tipton
Table Mt.
Whitehills
Truxton
Cherokee
Peach Springs
Stephens Spring
Hualpai Valley
Red Lake (Dry)
Detrital Valley
Sacramento Valley
Mt. Wilson
Squaw Peak
Gold Basin
Cyclone
Tinnaka Spring
Mt. Logan 7,700
Mt. Trumbull 7,700
Mt. Emma
Mt. Dellenbaugh 6,750
Castle Peak
Solitaire Butte
Diamond Butte
Dry Lake
St. Thomas
Moapa
Overton
Logandale
Carp
Lolth
Elgin
Littlefield
Mt. Bangs
Black Rock Spring
Cane Spring
Pakoon Spring
Pigeon Spring
Tapeats Creek
Tapeats Valley
Toroweap Valley
Toroweap Spr.
Cottonwood Spr.
Pipe Spring
Pipe Spring Valley
Hackberry
Grand Wash
Grand Wash Cliffs
Grand Wash Valley
Antelope Springs
Cane Spring
Yellow Rock
Antelope Spring
Black Rock Spring
Moccasin
Short Creek
Fredonia
Moccasin Springs
Cave Spring
Cave Bed Spring
Disc Springs
Hanging Rock
Mangum Spring
Big Spring
Kanab Canyon
House Rock Valley
Paria
Coconino
Grand Canyon
Red Hill
Apex
Hopi
Anita
Willaha
Valle
Quivero
Slate Mt.
Red Lake Mt.
Pitt
Williams
Sitgreaves
Wing Mt.
Agassiz Pk.
Mt. Elden
Leupp
Tolchaco
Grand Falls
Dry Lake
Indian Wells
Zuni Mt.
Twin Butte
Chimney Butte
Castle Butte
Pilot Rock
Lupton
Allantown
Chambers
Navajo
Squaw Spring
Pinto
Lime Mt.
Querino
Houck
Sanders
Adamana
Holbrook
Petrified Forest
Woodruff
Woodruff Butte
Penzance
Carrizo
Aztec
Apache Butte
Swamp
Sunset Crossing
Winslow
Moqui
Canon Diablo
Supaine
Ashurst Lake
Mt. Elden
Agassiz Pk.
Wing Mt.
Leroux
Delmonte
Riordan
Cosnino
Wilson
Gillespie
Fort Defiance
St. Michaels
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Alamo Spring
Zillesai Mesa
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Tsodzisa Spring
Lokanaka Spring
Nutahana Spring
Pra ga at zo Lake
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Heber
Valley
Snowflake
Taylor
Shumway
Pinedale
Silver Creek
Linden
Show Low
Lakeside
Spring Valley
Pinetop
Lake
Butte
Lava
Volcano
Springerville
Twin Butte
Hunt
Colorado
Thousand Cave Mt.
St. Johns
Concho
Little Colorado
Silver Creek Canyon
Wild Cat Canyon
Chevelon Canyon
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Table Mt.
Clear
Hog Nose Mt.
Stoneman Lake
Chaves Pass
Mt. Bronco Chaves Mt.
Mt. Nestor
Mt. Geronimo
Wilson Mt.
Boynton
Milos Butte
Sedona
Cornville
Cottonwood
Munds Mt.
Jerome
Jerome Jc.
Clarkdale
Verde
Verde R.
Tonto Basin
Payson
Rye
Gordon
Childs
Turret Peak
North Peak
Deadman Canyon
Magellan
Baker Butte
Mesa
Squaw Pk.
Blue Bell
Cordes
Stoddard
Foland
Jo. Baldy
Rutherford
Cherry Creek or Dewey P.O.
Camp Verde
Yeager
Cherry
Humboldt
Huron
Walker
McCabe
Prescott
Whipple
Skull Valley
Iron Springs
Ramsgate
Kirkland
Grand View
Hillside
Aquarius
Arastra
Signal Mt.
Aubrey Hills
Artillery Mts.
Artillery Peak
Steamboat Rock
Steamboat Peak
Crossman Peak
Bates Peak
Mohave Mts.
Mohave
Oatman
Boundary Mts.
Fort Mojave
Yucca
Yucca
Needles
Topock
Beal
Parker
Franconia
Hayland
Granite Peak
Cignus Peak
McHeffy Butte
Mesa
Mohon Mt.
Aztec Pass
Wilder Gap
Granite Mts.
Granite
Pumpkin Valley
Del Rio
Rockbutte
Picacho Butte
Bill Williams Mt.
Cedar Glade
Oasis
Rock Butte
Cross Mt. 6,020
Anvil Rock
Three Sister Buttes
Huaipai Peacock Peak 6,208
Huaipai Peak
Kingman
Hackberry
Antares
Berry
Louise
Drake
Kaster
McCompico
Hancock
Union
Bull's Head Rock
Black Mt.
Nutt
Ute
Oatman
Chloride
Keystone
Mineral Park
Cerbat
Oloonda
Cherum Peak
Mt. Perkins
Mt. Davis
Eagle Rock
Mt. Tipton
Table Mt.
Whitehills
Truxton
Cherokee
Peach Springs
Stephens Spring
Hualpai Valley
Red Lake (Dry)
Detrital Valley
Sacramento Valley
Mt. Wilson
Squaw Peak
Gold Basin
Cyclone
Tinnaka Spring
Mt. Logan 7,700
Mt. Trumbull 7,700
Mt. Emma
Mt. Dellenbaugh 6,750
Castle Peak
Solitaire Butte
Diamond Butte
Dry Lake
St. Thomas
Moapa
Overton
Logandale
Carp
Lolth
Elgin
Littlefield
Mt. Bangs
Black Rock Spring
Cane Spring
Pakoon Spring
Pigeon Spring
Tapeats Creek
Tapeats Valley
Toroweap Valley
Toroweap Spr.
Cottonwood Spr.
Pipe Spring
Pipe Spring Valley
Hackberry
Grand Wash
Grand Wash Cliffs
Grand Wash Valley
Antelope Springs
Cane Spring
Yellow Rock
Antelope Spring
Black Rock Spring
Moccasin
Short Creek
Fredonia
Moccasin Springs
Cave Spring
Cave Bed Spring
Disc Springs
Hanging Rock
Mangum Spring
Big Spring
Kanab Canyon
House Rock Valley
Paria
Coconino
Grand Canyon
Red Hill
Apex
Hopi
Anita
Willaha
Valle
Quivero
Slate Mt.
Red Lake Mt.
Pitt
Williams
Sitgreaves
Wing Mt.
Agassiz Pk.
Mt. Elden
Leupp
Tolchaco
Grand Falls

ARIZONA
SCALE
Statute Miles, 39=1 Inch.
0 10 20 30 40 50
Railroads
Electric Lines
Rand McNally's 11 x 14 Map of Arizona.
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MEXICO
CALIFORNIA
GULF OF
Harqua Hala Desert
Yuma Desert
Tule Desert
Colorado River
Gila River
Salt River
Phoenix
Tucson
Florence
Casa Grande
San Carlos
Globe
Clifton
Solomonsville
Douglas
Bisbee
Tombstone
Nogales
Fort Apache
San Carlos Indian Reservation
Gila Bend Indian Reservation
Papago Ind. Reservation
Fort Grant Mil. Res.
Fort Huachuca Mil. Res.
Tumacacori Nat'l Monument
Casa Grande Ruin Res.
Roosevelt Reservoir
Apache Mts.
Superstition Mts.
Pinal Mts.
Santa Rita Mts.
Huachuca Mts.
Chiricahua Mts.
Pedregosa Mts.
Dragoon Mts.
Whetstone Mts.
Rincon Mts.
Catalina Mts.
Tortilla Mts.
Galiuro Mts.
Graham Mts.
Gila Mts.
Castle Dome Mts.
Gila Bend Mts.
Maricopa Mts.
Sierra Estrella
Sierra Ancha
Mazatzal Mts.
Mogollon Rim
Black Mesa
Mt. Graham
Mt. Turnbull
Mt. Lemmon
Mt. Wrightson
Mt. Hopkins
Mt. Baldy
Mt. Ord
Mt. Thomas

Tempe and Flagstaff and 17 high schools. There are also numerous private and sectarian schools. The government and various sectarian organizations maintain 59 boarding and day schools for Indians among the various tribes and there are also government non-reservation schools at Phoenix and Fort Mohave. In 1916 these had a capacity of 5,275 pupils, a total enrolment of 5,076 and an average attendance of 4,159.

Religious.— Owing to the large number of persons of Spanish descent, locally known as "Mexicans," and to the activities of the early Jesuit and Franciscan missionaries, more than half the communicants in the State are of the Roman Catholic faith, followed in order by the Latter Day Saints (Mormons), Presbyterians and Methodists. So far as the statistics are available, the Roman Catholics and the Methodists have an almost equal number of church organizations, and the Roman Catholics and Episcopalians an equal number of church buildings. In value of church property the Catholics exceed the Methodists only slightly, while in indebtedness the Catholic churches greatly exceed that of any other denomination. The Methodists have a greater number of Sunday-schools than any other religious organization, followed by the Catholics and the Latter Day Saints respectively; while in Sunday-school pupils the order is Latter Day Saints, Methodists, Catholics, Presbyterians, and Baptists.

Charitable, Penal.— The State maintains an asylum for the insane near Phoenix, a home for aged and infirm pioneers at Prescott, the Florence Crittenden Home and Children's Home at Phoenix, a penitentiary at Florence and an industrial school for juvenile offenders on the site of Fort Grant near Willcox. The University of Arizona maintains a department for the deaf.

Population and Divisions.— The first separate census was taken in 1870, giving, exclusive of Indians, 9,658; in 1880, 40,440; in 1890, 88,243 (including Indian lands and reservations); in 1900, 122,931; in 1910, 204,354; in 1917 (est.), 263,788. The principal Indian tribes are: Navajo (partly in New Mexico), 21,763; Papago, 7,112; Pima, 4,892; San Carlos Apache, 2,584; White Mountain Apache, 2,384; other Apache, 646; Mohave, 584; Hopi, 2,476; Walapai, 470; Maricopa, 269; Chemehuevi, 1,002; Havasupai, 170; Paiute, 285. There are 14 counties in the State, as follows, with their county seats, population, etc.:

In addition to towns named in table, the following contained more than 1,000 inhabitants in 1910: Bisbee, 9,019; Douglas, 6,937; Jerome, 2,393; Winslow, 2,381.

Government.— Sessions of the legislature are held biennially, commencing on the second Monday of January next after the election of members of the legislature. By constitutional provision the people reserve the power and privileges of initiative and referendum. Women were granted full suffrage in 1912 and in 1914 the State declared for absolute prohibition against the manufacture, sale or transportation of intoxicants. The hours of labor for women in laundries, bakeries, mercantile establishments, hotels and restaurants and also in telegraph and telephone offices in which more than three women are employed shall not exceed eight hours per day or 56 hours a week; for females under 18, the maximum is 48 hours a week. For females under 18, night work is prohibited from 7 P.M. to 7 A.M. The law provides also that seats shall be furnished in mills, factories, mercantile establishments, laundries and offices. Mothers are provided pensions under certain conditions. Eight hours constitute a lawful day's work in all employment by or in behalf of the State or any political subdivision thereof, and also in most cases the same length of day is provided for all workers in mines, smelters, etc. No child under 14 years of age shall be employed in any gainful occupation during school hours and no child under 16 years of age shall be employed in a mine or in any other injurious or hazardous occupation, or in any occupation at night. Female labor in or about any mine, quarry or coal-breaker is prohibited. Provision is made for employers' liability and for compulsory compensation applicable to workmen engaged in dangerous occupations. The minimum wage for females (except family domestics) is $10 per week.

Archæology.— Practically throughout the State are the remains of innumerable structures, the homes of Indian tribes in former times. The more celebrated of these are Casa Grande, the main building of a large group of similar structures near Florence; the cliff-dwellings of the Navajo National Monument within the Navajo Indian Reservation in the extreme northern part of the State; Montezuma Castle on Beaver Creek near old Camp Verde; the cliff-dwellings of Walnut Canyon near Flagstaff and near the Roosevelt Dam. Many others are situated along the water-courses,

County	Area, sq. mi.	Population, 1917 (est.)	Assessed value, 1912†	County-seat	Population 1910
Apache	10,736	9,853	$2,369,479	St. Johns	835
Cochise	6,147	53,089	32,500,762	Tombstone	1,582
Coconino	19,322	10,041	6,808,956	Flagstaff	1,633
Gila	4,542	22,993	10,661,644	Globe	7,083
Graham	6,500	*30,601	3,670,178	Solomonsville	595
Greenlee	.....	.....	10,568,766	Clifton	4,874
Maricopa	8,816	44,731	27,599,786	Phoenix	11,134
Mohave	13,421	4,026	5,973,265	Kingman	900
Navajo	9,826	13,399	3,094,025	Holbrook	609
Pima	9,424	28,751	8,955,961	Tucson	13,193
Pinal	5,324	9,968	5,123,447	Florence	807
Santa Cruz	1,212	8,387	2,418,170	Nogales	3,514
Yavapai	7,863	17,598	16,111,921	Prescott	5,092
Yuma	9,787	10,351	4,481,831	Yuma	2,914

* Includes the population of Greenlee County, organized from part of Graham County, 1 Jan. 1911.

† Assessed valuation of all property (real, $144,332,802; personal, $56,282,974; other, $207,924,507), $408,540,283. The total assessed valuation of all property subject to ad valorem taxation (see table) is $140,338,191, or $608.03 per capita.

and indeed in many instances away from any present water supply. These remains for the greater part are probably at least a thousand years old, but others show evidence of having been inhabited not very long before the discovery of America, while still others were doubtless occupied within the historic period.

History.— The first white men to enter Arizona were probably Juan de la Asunción and Pedro Nadal, two friars of whom little is known, who penetrated the region in 1538. Fray Marcos of Niza and his negro companion Estevañico, in 1539, journeyed from Mexico to the sources of the Rio San Pedro, thence across the southeastern part of the present State to the province of Cibola. (See NEW MEXICO). In the following year Niza served as guide to Francisco Vasquez Coronado, who, with a considerable force, visited Cibola and sent two small expeditions which discovered the Hopi villages (called Tusayan) and the Grand Cañon of the Colorado. Meanwhile other parties went from the settlement which Coronado established on the Rio Sonora in northwestern Mexico, explored the region, later known as the Papagueria (from the Papago Indians), to the mouth of the Colorado, where letters had been buried by Hernando de Alarcon who commaned a joint expedition by sea and went up the Colorado for 85 leagues. Antonio de Espejo visited the Hopi villages in the northeastern part in 1583, as did Juan de Oñate, the first governor and colonizer of New Mexico, in 1598, the latter also passing entirely across the State to the mouth of the Colorado and back in 1604–05. The first missions were established among the Hopi by Franciscans in the summer of 1629, which, barring the killing of some of the missionaries by the Indians, were successfully continued until August 1680, when, in a general uprising of the Pueblos, the missionaries were murdered and little effort made thenceforth to introduce Christianity. From 1687 the Jesuits, particularly Padre Eusebio Kino, made various journeys into southern Arizona, establishing the missions of San Xavier del Bac in 1699 or 1700, and that of Guevavi in 1732. The present church of San Xavier was begun about 1783 and finished in 1797. In 1752 a presidio was established at Tubac, but in 1776 it was removed to a rancheria of about 80 families of Pima, Papago, and Sobaipuri Indians, known as San Augustin de Tucson (the present Tucson) a few miles northward, at which a few Spaniards may also have settled after 1763. Another mission of importance, the walls of whose fine church are still standing, was that of San José Tumacacori, erected in 1752. The missions and their *visitas* led a precarious existence after 1750–53, during which years the Pima were at war against the Spaniards, killing several priests and plundering the missions, including that of San Xavier. The Jesuits were expelled in 1767 and were followed by Franciscans, who rehabilitated the mission settlements and conducted explorations in unknown or forgotten regions. For many years before and after, the Apache tribes were at almost constant war with the more sedentary Indians of southern Arizona, raiding their settlements, killing the men and carrying off the women; nor did the white settlements fare much better, notwithstanding the presence of presidios. At the time of the conquest of New Mexico in 1846 by Gen. S. W. Kearny, Arizona formed a part of that territory. By the Treaty of Guadalupe Hidalgo in 1848 the section north of the Gila was ceded by Mexico to the United States, while that south of the river was obtained through the Gadsden Purchase (q.v.), approved in 1854. Raids continued, various military expeditions were conducted and outposts established, and rich mineral deposits were discovered during the next few years. By act of Congress approved 24 Feb. 1863, Arizona was erected into a separate Territory, and on 29 December it was formally organized at Navajo Springs. The withdrawal of troops from the frontier at the beginning of the Civil War left the country practically at the mercy of Apaches, who continued their depredations; mines were abandoned and settlements deserted, but with the re-establishment of the military posts the development of the Territory was renewed and has since continued.

In June 1910 Congress passed an act to enable Arizona and New Mexico to form State constitutions and governments and to be admitted to the Union. In December of that year a proposed State constitution for Arizona was adopted by a convention held at Phoenix and was ratified by the people in February 1911. This constitution received the conditional approval of the Federal government in August 1911 and was referred to the people of the Territory for amendment. On 14 Feb. 1912 the Territory became a State of the Union.

The Territorial and State governors have been:

TERRITORIAL

John N. Goodwin	Republican	1863–66
Richard C. McCormick	"	1866–69
A. P. K. Safford	"	1869–77
John P. Hoyt	"	1877–78
John C. Fremont	"	1878–81
Frederick A. Tritle	"	1881–85
C. Meyer Zulick	Democrat	1885–89
Lewis Wolfley	Republican	1889–90
John N. Irwin	"	1890–92
Nathan O. Murphy	"	1892–93
Louis C. Hughes	Democrat	1893–96
Benjamin J. Franklin	Republican	1896–97
Myron H. McCord	"	1897–98
Nathan O. Murphy	"	1898–1902
Alexander O. Brodie	"	1902–05
Joseph H. Kibbey	"	1905–09
Richard E. Sloan	"	1909–12

STATE

G. W. P. Hunt	Democrat	1912–

Bibliography.—Although among the youngest of the States, the literature of Arizona is voluminous. For a list of writings on the subject, consult Hector Alliot, 'Bibliography of Arizona, (Los Angeles 1914). The publications of the Federal government cover a very wide range of subjects and are embodied in the reports and bulletins of the Bureau of American Ethnology of the Smithsonian Institution, the Bureau of the Census and the War Department (especially the reports and narrations of various engineer officers of the army in the forties and fifties); the Mineral Resources of the United States, published by the Geological Survey, the reports of the governors of Arizona published by the United States Department of the Interior during the territorial government of Arizona; the bulletins of the United States Bureau of Labor Statistics, the circulars of the Children's Bureau, etc. For more general information on various topics

regarding Arizona, consult Bancroft, H. H., 'History of Arizona and New Mexico' (San Francisco 1889); Benavides, Fray Alonso, 'Memorial' (trans. by Mrs. E. E. Ayer; annotated by F. W. Hodge and C. F. Lummis, Chicago 1916); Bolton, H. E., 'Spanish Exploration in the Southwest, 1542–1706' (New York 1916); Bourke, J. G., 'The Snake-Dance of the Moquis of Arizona' (ib. 1884); id., 'An Apache Campaign' (ib. 1886); id., 'On the Border with Crook' (ib. 1891); Coues, E., 'On the Trail of a Spanish Pioneer; The Diary and Itinerary of Francisco Garcés' (ib. 1900); Dellenbaugh, F. S., 'Romance of the Colorado River' (ib. 1903); DeLong, S. R., 'History of Arizona' (San Francisco 1905); Farish, T. E., 'History of Arizona' (Phœnix 1915); Hough, Walter, 'Archeological Field Work in Northeastern Arizona' (Washington 1903); id., 'Culture of the Ancient Pueblos of the Upper Gila' (ib. 1914); id., 'The Hopi Indians' (Cedar Rapids 1915); James, G. W., 'In and Around the Grand Canyon' (Boston 1900); id., 'Arizona the Wonderland' (ib. 1917); McClintock, J. H., 'Arizona, Prehistoric, Aboriginal, Pioneer, Modern' (Chicago 1916); Powell, J. W., 'Report of Explorations of the Colorado of the West' (Washington 1874); Prudden, T. M., 'On the Great American Plateau' (New York 1906).

F. W. Hodge,
Smithsonian Institution, Washington, D. C.

ARIZONA, University of, State institution, established by the legislature in 1885 and opened in 1891 at Tucson, Ariz. Its buildings and grounds are valued at about $500,000. The United States government appropriates annually $50,000 to the institution and the State appropriation amounts to $120,000. The library contains 23,000 volumes and in 1917 there were in the institution 52 professors and instructors and 450 students. The departments are those of agriculture, civil, electric, mechanical and mining engineering, commerce, liberal arts, and economics.

ARK, (1) the box made of bulrushes in which Pharaoh's daughter found the infant Moses. (2) The great vessel or ship in which Noah took refuge during the deluge. According to the story in Genesis, Noah's ark was large enough to contain his family and representatives of each kind of animal. Its dimensions were 450 feet long, 75 feet broad and 45 feet high. It was made of "gopher" wood, which has been variously identified with cypress, pine, and cedar. Until the advent of "the higher criticism" there were many theories as to the number of animals and the space necessary for their reception. Modern criticism and the surrender of attempts to square scientific facts with a literal interpretation of the Bible are indicated by the following suggestion of Bishop Stillingfleet, approved by many eminent authorities: "The insuperable difficulties connected with the belief that all the existing species of animals were provided for in the ark, are obviated if we assume that the deluge did not extend beyond the region of the earth then inhabited, and that only the animals of that region were preserved in the ark." (3) A chest or cupboard in the Jewish synagogue in which are placed the scrolls of the Torah. It is placed against or in the wall in the direction of Jerusalem. (4) The Ark of the Covenant, Ark of the Revelation, Ark of the Testimony, are the full names of the sacred chest of acacia wood, overlaid with gold, which the Israelites took with them on their journey into Palestine. It was an oblong box three feet nine inches in length, two feet three inches broad and the same in height. It was lined within and without with gold, and through four golden rings were placed staves of acacia wood, by means of which it was carried. In it were preserved the tables of the law. It was borne by the Levites, often at the head of a battle host, and had an eventful history before it was finally placed in the city of Jerusalem by David. Later its importance was apparently merged with that of the Temple which Solomon erected. There is no record of when or how it finally disappeared, but there are many popular legends regarding it, one of which speaks of its translation to heaven until the coming of the Messiah.

ARKADELPHIA, Ark., county-seat of Clark County, 65 miles southwest from Little Rock. It is situated on the banks of Ouachita River, on the Saint Louis, Iron Mountain and Southern Railroad. Its industries include cotton mills, a foundry, machine shops and a roller mill. A Baptist and a Methodist college are located here, and there is a Presbyterian school for negro children. Pop. 2,745.

ARKANSAS, ăr'kăn-sâ, the "Bear State." A south-central State of the United States, bounded on the north by Missouri, on the east by Missouri and the Mississippi River, on the south by Louisiana and Texas, on the west by Texas and Oklahoma. It measures about 250 miles north and south and from 175 to 275 east and west. Area, 52,525 square miles of land, 810 of water. Capital, Little Rock (q.v.).

Topography.— About one-fourth of the State is mountainous. In the northwest are the Ozark Mountains (q.v.), a continuation of that system from Missouri. The most extensive ranges are the Boston Mountains north of the Arkansas River and the Ouachita south. The highest peak is Magazine Mountain, 2,785 feet, in Logan County. Several others approach 2,000 feet. There are several unexplored caves of large dimensions, notably in Newton and Washington counties. Broken ranges extend eastward on the north as far as Sharpe and Independence counties and to Pulaski, Pike and Howard on the south. East and south of a line connecting these counties is a considerable tract of hilly country sloping east and south. Beyond this and extending to the Mississippi are the alluvial lands, swamps, lakes and bayous of the river "bottoms" 40 to 50 miles wide. The elevation of this region ranges from 350 feet along the border of the uplands to 100 feet in the extreme southeast. Much of it, excepting the prairie lands of Lonoke, Prairie and Arkansas counties, is still subject to overflow, though a considerable area has been recovered by a splendid system of drainage ditches and levees.

Hydrography.— Except for a few miles on the north the Mississippi touches the State on its entire eastern border. Four large tributaries flow through the State. The Saint Francis (450 miles long) parallels the Mississippi from the Missouri border to a short dis-

tance above Helena. The region between the two is full of swamps and lakes, but is dotted with thriving settlements. The White River (800 miles) rises in Arkansas, passes into Missouri, re-enters the State, receives the Black (400 miles) at Jacksonport, the Cache near Clarendon, and enters the Mississippi in Arkansas County. The Arkansas River (q.v.), bisects the State from northwest to southeast and enters the Mississippi just below the White. It has no considerable tributaries. The Red River crosses the southwestern corner and receives the Ouachita (500 miles), which leaves the State through Union County. An incomplete survey of the streams in the northwest showed 525,000 horse-power. The total in the State probably amounts to 1,000,000.

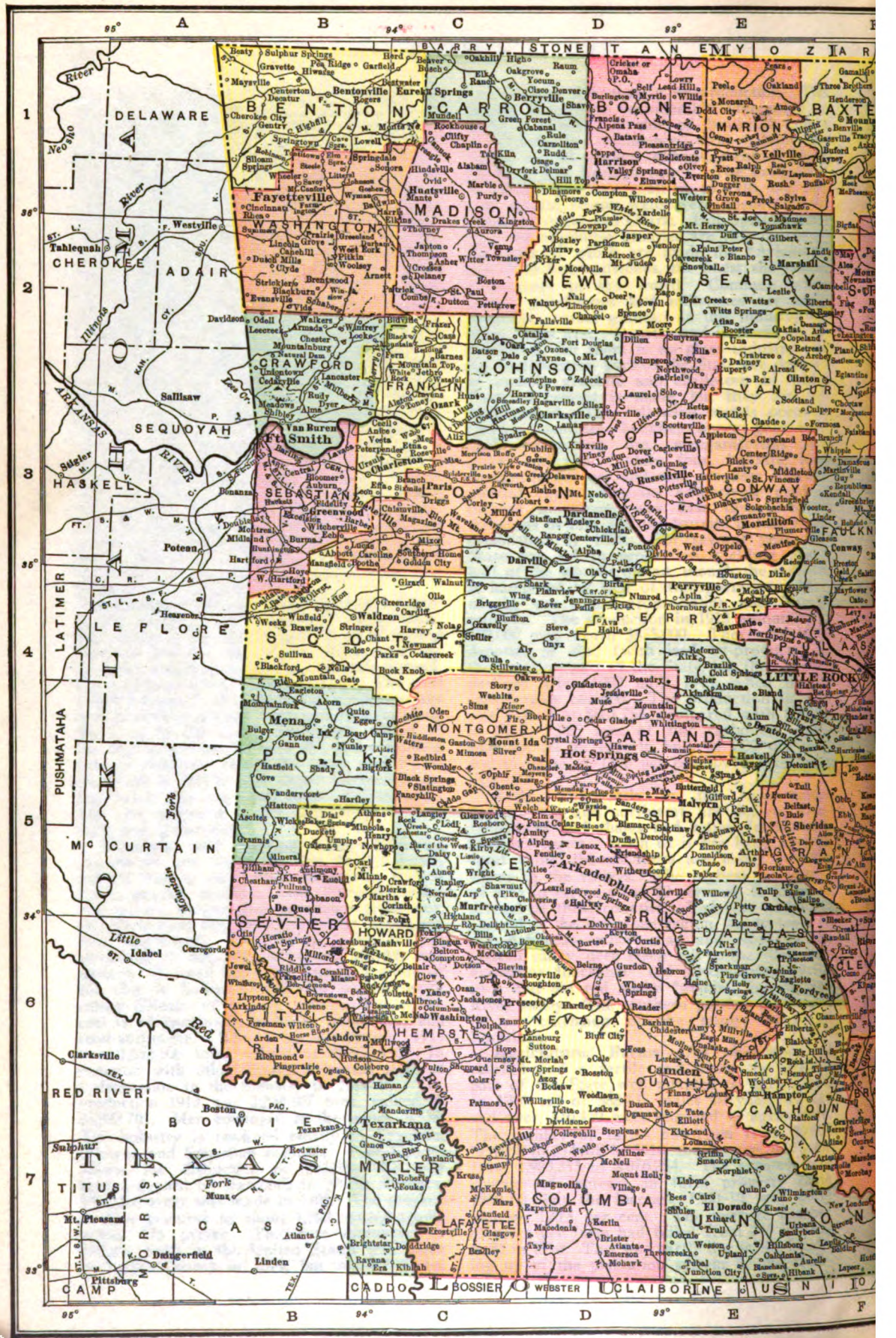
Climate and Sanitary Conditions.— The mean temperature is 60.8; for the winter 41.6, summer 78.9; lowest on record —32 (1862), highest 112. The variation between the northern and southern part of the State is about 5 degrees. The average rainfall is 46.7; it is somewhat higher in the eastern and southern part. Severe droughts are unknown. Floods are common in the river sections. The eastern and southern river bottoms are hot and malarial, but drainage has improved conditions greatly and a beginning has been made of the destruction of the mosquito. The uplands are healthful and the Ozark region is much frequented as a summer resort.

Geology.— Several distinct periods of geological formation are represented in the State. The oldest is the Ordovician, found in several counties between the White River and the Missouri boundary and a narrow strip extending westward from Pulaski County. The next oldest belongs to the Lower Carboniferous age and extends in general from east to west along the crest of the Ozark Mountains. Most of the region between 34° and 36°, and extending east to meridian 93 on the south and 91 on the north is Middle and Upper Carboniferous. Just below this is a small patch of Cretaceous. The rest eastward to the Mississippi is Tertiary and Quaternary.

Minerals and Mining.— The following non-metals are found in the State: Agate, asphalt, basalt, clay, coal, diamonds, fuller's earth, granite, graphite, lime, limestone, mineral waters, natural gas, novaculite (oilstone), phosphate rock, salt, sand and gravel, sandstone, slate, and tripoli. The clay products for 1914 amounted to $451,986, of which $19,400 was pottery. A small beginning has been made of the clay in Saline County for pottery work called Niloak, of a very artistic type. The coal is of two kinds, ordinary bituminous and semi-anthracite. The total production 1915 was 1,652,106 tons, valued at $2,950,456. In common with other States Arkansas suffered a depression in the industry in 1914–15. The production 1913 was 2,234,107 tons, valued at $3,923,701. Men employed in the mines, 4,339. The industry is confined mostly to Franklin, Johnson and Sebastian counties. Pike County enjoys the distinction of holding the only known deposit of diamonds in North America. The discovery was made in 1906. The product to date amounts to about 1,700 stones aggregating 575 carats. The first discovery of fuller's earth in the United States was made in Saline County in 1891, but several States now surpass Arkansas in its production. The granite industry is considerable, amounting to $378,110 (1913). Marble of beautiful colors is found in abundance near Batesville. There are 18 mineral springs, most of them found at Hot Springs (q.v.). The production of natural gas was small up to 1916, but that year several strong wells were opened in the region of Alma and Ozark. Hot Springs, Garland and adjoining counties are rich in novaculite, out of which are made the "Arkansas" and "Ouachita" oilstones, the finest sharpening instruments in the world. Common whetstones, grindstones and millstones are made from the coarser grades. In this industry the State ranks first. Quartz sand is found in the northwest, but there is no glass industry. In the southwestern part of the State are deposits of asphalt, graphite and chalk out of which Portland cement is made, but they are still undeveloped. The following metals occur in varying quantities: bauxite, copper, gold, iron, lead, manganese ore, manganiferous ore, nickel and zinc. Only four, bauxite, lead, manganiferous ore and zinc are now of commercial value. Bauxite, extensively used in making aluminum, was first discovered in Arkansas in 1891 and the bauxite industry was established by 1896. For several years the State has led in production, yielding nearly half of the world's output, though the industry is hampered by lack of transportation. Most of the ore comes from Saline and Pulaski counties. The production in 1913 amounted to 180,000 tons worth $855,000. There are large deposits of zinc (with lead by-products) in the northern part of the State, but the industry declined after 1908 until 1915, when it was considerably revived. The production in 1915 was valued at $801,754, compared with $65,214 in 1914; 7,925 tons of zinc carbonate, value $408,079, an increase in bulk of 700 per cent, and in value of 1500 per cent over 1914, were exported.

Soils.— The soils in the mountainous region, west and northwest, are derived from sandstones and shales and range from sandy to heavy loams. Much of it has little agricultural value, though there are many valuable farms in the valleys. The highest percentage of area in farms, 60 to 80 per cent, is found in several of these counties. Red clay and loam abound in the limestone region, sandy loam in the Arkansas valley, clay and sand in the eastern valley, deep black soil in the "bottoms" known as "buckshot" (of inexhaustible fertility), and the red sticky "gumbo" in the Red River valley. The southern portion is covered by an extension of the sandy loams of Louisiana.

Agriculture, Farms.— An abundance of rainfall and a fertile soil make the greater part of the State well adapted to agriculture. In 1910 out of 588,133 males 10 years of age and over, 510,410 were engaged in agriculture. The number of farms has risen from 39,004 in 1860 to 214,678 in 1910, the acreage in farms from 1,983,313 to 8,076,254. The greatest percentage of increase in farm property came 1850–60, but the increase 1900–10 was noteworthy, 120.5 per cent. The average number of acres per farm had fallen from 245 in 1860 to 81 in 1910. This was partly due to the breaking up of the plantation system or the aboli-


BENTON
WASHINGTON
CRAWFORD
SEBASTIAN
LOGAN
YELL
PERRY
SALINE
GARLAND
MONTGOMERY
POLK
SCOTT
MADISON
CARROLL
BOONE
NEWTON
JOHNSON
POPE
CONWAY
FAULKNER
PULASKI
LITTLE ROCK
MARION
BAXTER
SEARCY
VAN BUREN
FRANKLIN
SEQUOYAH
LE FLORE
PUSHMATAHA
LATIMER
HASKELL
MCCURTAIN
DELAWARE
CHEROKEE
ADAIR
Fayetteville
Fort Smith
Van Buren
Mena
Waldron
Paris
Danville
Russellville
Clarksville
Harrison
Yellville
Marshall
Batesville
Conway
Little Rock
Hot Springs
Malvern
Arkadelphia
Prescott
Nashville
De Queen
Murfreesboro
Texarkana
Hope
Camden
Magnolia
El Dorado
Warren
Monticello
Hampton
Benton
Bentonville
Springdale
Rogers
Huntsville
Eureka Springs
Berryville
Green Forest
Mountain Home
Flippin
Cotter
Gassville
Mountain View
Heber Springs
Searcy
Clinton
Morrilton
Dardanelle
Ozark
Booneville
Greenwood
Fort Smith
Alma
Van Buren
Charleston
Ozark
Paris
Danville
Dardanelle
Russellville
Atkins
Morrilton
Conway
Perryville
Little Rock
North Little Rock
Benton
Bryant
Hot Springs
Malvern
Arkadelphia
Gurdon
Prescott
Nashville
De Queen
Murfreesboro
Texarkana
Hope
Camden
Magnolia
El Dorado
Warren
Monticello
Hampton
Red River
Little River
Fourche
Ouachita
Saline
Caddo
Bossier
Webster
Claiborne
Union
Columbia
Lafayette
Miller
Howard
Sevier
Pike
Clark
Dallas
Calhoun
Ouachita
Union
Texas
Titus
Morris
Cass
Camp
Pittsburg
Mt. Pleasant
Daingerfield
Linden
Atlanta
Lafayette
Miller
Columbia
Nevada
Hempstead
Lafayette
Little River
Red River
Bowie
Texarkana
Boston
Clarksville
Idabel
Broken Bow
Mena
Waldron
Hot Springs
Malvern
Arkadelphia
Prescott
Nashville
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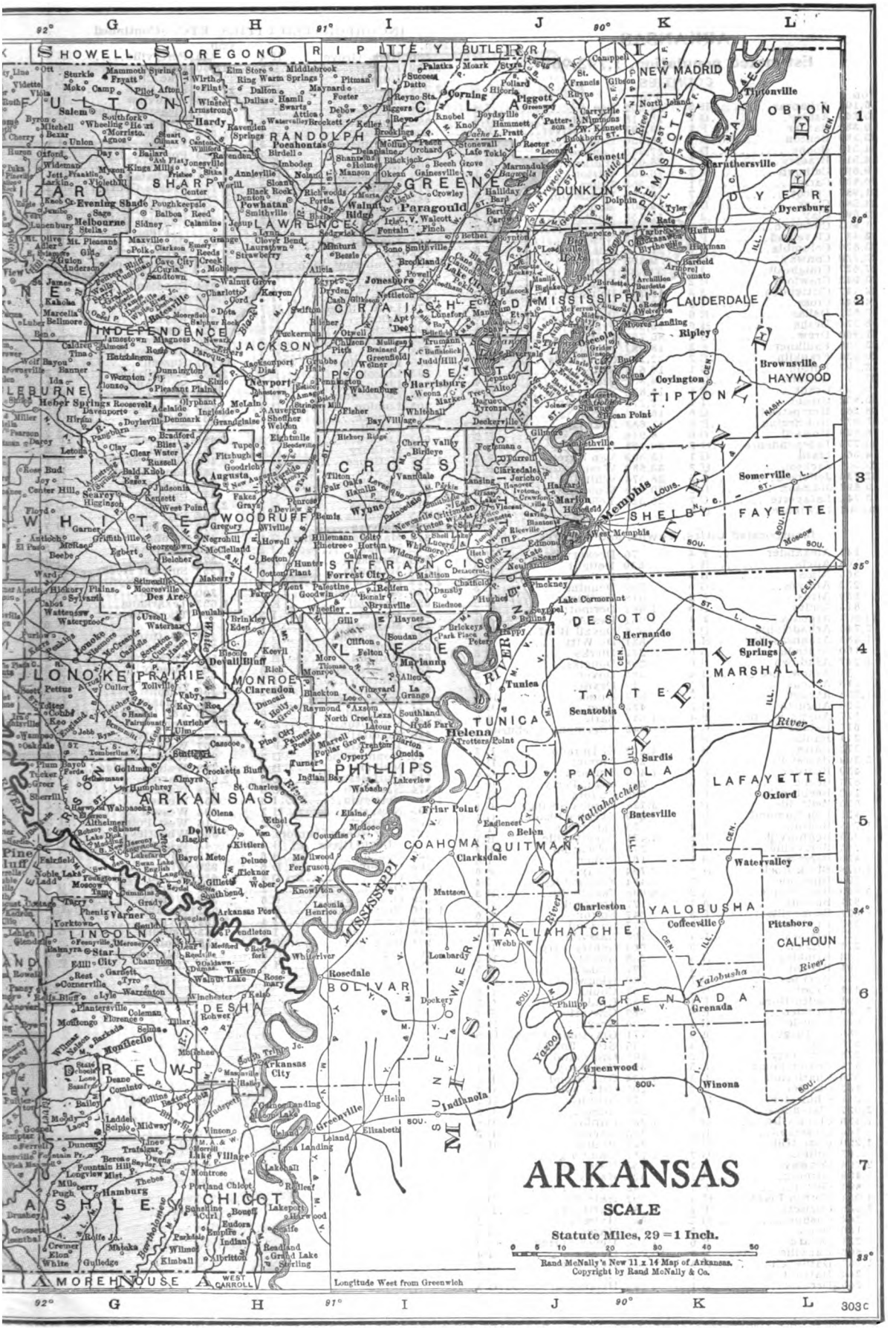
ARKANSAS
SCALE
Statute Miles, 29 = 1 Inch.
0 5 10 20 30 40 50
Rand McNally's New 11 x 14 Map of Arkansas.
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Longitude West from Greenwich
92° G H 91° I J 90° K L
1 2 3 4 5 6 7
35° 34° 33°
SHOWELL
OREGON
RIPLEY
BUTLER
NEW MADRID
FULTON
RANDOLPH
CLAY
GREENE
DUNKLIN
OBION
IZARD
SHARP
LAWRENCE
Paragould
Jonesboro
Dyersburg
Evening Shade
Melbourne
Batesville
Carruthersville
Dyer
INDEPENDENCE
JACKSON
CRAIGHEAD
POINSETT
MISSISSIPPI
LAUDERDALE
Ripley
Brownsville
HAYWOOD
TIPTON
LEBURN
Heber Springs
Harrisburg
Coyington
Marion
Memphis
SHELBY
FAYETTE
Somerville
WHITE
WOODRUFF
CROSS
ST. FRANCIS
Forrest City
Wynne
Augusta
Bemis
Clarkedale
Jericho
Lake Cormorant
DESOTO
Hernando
Holly Springs
MARSHALL
LONOKE
PRAIRIE
MONROE
LEE
Marianna
Devall Bluff
Clarendon
Helena
TUNICA
Tunica
Senatobia
TATE
PANOLA
Sardis
LAFAYETTE
Oxford
PHILLIPS
ARKANSAS
Friar Point
Batesville
COAHOMA
QUITMAN
Clarksdale
Watervalley
DeWitt
Kittrell
Elaine
Lakeview
Indian Bay
Arkansas Post
Charleston
YALOBUSHA
Coffeeville
Pittsboro
CALHOUN
LINCOLN
Star City
Pendleton
Lombardy
TALLAHATCHIE
Webb
Rosedale
BOLIVAR
Dockery
GRENADA
Grenada
DESHA
Arkansas City
DREW
Greenville
Leland
Elizabeth
Indianola
Yazoo City
Greenwood
Winona
ASHLEY
CHICOT
Hamburg
Portland
Lake Village
Lakeport
Eudora
Crossett
Wilmot
Kimball
Sterling
MORE
HOUSE
WEST CARROLL
Mississippi River
Tallahatchie River
Yalobusha River
Yazoo River
Sunflower River

303c

ARKANSAS

Estimated population, 1,792,965

COUNTIES

Pop.			Pop.		
16,103	Arkansas	H 5	24,252	Lee	I 4
25,268	Ashley	G 7	15,118	Lincoln	G 6
10,389	Baxter	F 1	13,597	Little River	B 6
33,389	Benton	B 1	26,350	Logan	C 3
14,318	Boone	D 1	27,983	Lonoke	G 4
14,518	Bradley	F 7	26,056	Madison	C 1
9,894	Calhoun	E 7	10,203	Marion	E 1
16,829	Carroll	C 1	19,555	Miller	C 7
21,987	Chicot	H 7	10,468	Mississippi	J 2
23,686	Clark	D 5	39,907	Monroe	H 4
23,690	Clay	J 1	12,455	Montgomery	C 4
11,903	Cleburne	F 3	19,344	Nevada	D 6
13,481	Cleveland	F 6	10,612	Newton	D 2
23,820	Columbia	D 7	21,774	Ouachita	E 6
22,729	Conway	E 3	9,402	Perry	E 4
27,627	Craighead	I 2	33,535	Phillips	I 5
23,942	Crawford	B 2	12,565	Pike	C 5
22,447	Crittenden	J 3	12,791	Poinsett	I 2
14,042	Cross	I 3	17,216	Polk	B 5
12,621	Dallas	E 6	24,527	Pope	D 3
15,274	Desha	H 6	13,853	Prairie	G 4
21,960	Drew	G 6	86,751	Pulaski	F 4
23,708	Faulkner	F 3	18,987	Randolph	I 1
20,638	Franklin	C 2	22,548	St. Francis	I 3
12,193	Fulton	G 1	16,657	Saline	E 4
27,271	Garland	D 4	14,302	Scott	B 4
9,425	Grant	F 5	14,825	Searcy	E 2
23,852	Greene	I 1	52,278	Sebastian	B 3
28,285	Hempstead	C 6	16,616	Sevier	B 6
15,022	Hot Spring	E 5	11,688	Sharp	G 1
16,898	Howard	C 6	8,946	Stone	F 2
24,776	Independence	G 2	30,723	Union	E 7
14,561	Izard	G 1	13,509	Van Buren	E 2
23,501	Jackson	H 2	33,889	Washington	B 2
52,734	Jefferson	G 5	28,574	White	G 3
19,698	Johnson	D 2	20,049	Woodruff	H 3
13,741	Lafayette	C 7	26,323	Yell	D 4
20,001	Lawrence	H 1			

Incorporated Cities, Towns, and Villages

141	Alexander	F 4	76	Deckerville	J 3
168	Alicia	H 2	539	Delight	C 6
565	Alma	B 3	162	Dell	K 2
252	Almyra	G 5	757	Denning	C 3
659	Altus	C 3	2,018	De Queen	B 5
813	Amity	D 5	1,662	Dermott	H 7
14,907	Argenta	F 4	1,061	Des Arc	G 4
2,745	Arkadelphia	D 5	924	Devall Bluff	H 4
1,485	Arkansas City	H 6	831	De Witt	H 5
160	Arkinda	B 6	272	Dierks	C 5
1,247	Ashdown	B 6	298	Douglas	H 6
31	Askew, Lee	I 4	385	Dover	D 3
115	Athens	B 5	18	Dryden	I 2
1,258	Atkins	E 3	519	Dumas	H 6
1,520	Augusta	H 3	433	Dyer	B 3
177	Austin Station	F 4	1,542	Earle	I 3
617	Baldknob	G 3	342	Edgemont, Cleburne	F 3
244	Banks	F 6			
272	Bates	B 4	4,202	El Dorado	E 7
3,399	Batesville	G 2	270	Emmet	D 6
439	Bearden	E 6	1,407	England	G 4
873	Beebe	G 3	292	Esau, Perry	E 4
142	Beebranch	F 3	606	Eudora	H 7
335	Belleville	C 3	3,228	Eureka Springs	C 1
431	Ben Lomond	B 6	289	Evening Shade	G 1
1,708	Benton	E 4	53	Fair Oaks	I 3
1,956	Bentonville	B 1	4,471	Fayetteville	B 1
785	Berryville	C 1	273	Felsenthal	F 7
435	Biggers	I 1	165	Fisher	I 3
1,078	Black Rock	H 1	2,794	Fordyce	F 6
296	Blissville	G 7	2,484	Forrest City	I 4
3,849	Blytheville	K 2	28,638	Fort Smith	B 3
811	Bonanza	A 3	177	Frostville	C 7
1,631	Booneville	C 3	647	Fulton	C 6
382	Bradford	G 3	277	Garland	C 7
123	Bradley	C 7	196	Gassville	F 1
271	Branch	C 3	668	Gentry City	B 1
5,133	Brinkley	H 4	256	Gillett	H 5
91	Bryant	E 4	291	Gillham	B 5
240	Buckner	D 7	768	Glenwood	C 5
441	Cabot	G 4	57	Gould	G 6
401	Calico Rock	F 1	180	Grady	G 5
3,995	Camden	E 6	569	Gravette	B 1
516	Carlisle	G 4	136	Grays	H 3
386	Carthage	E 5	771	Graysonia, Clark	D 5
310	Casa	D 4	635	Green Forest	C 1
278	Cave City	G 2	108	Greenland	B 2
328	Center Point	C 5	390	Greenway	J 1
576	Charleston	C 3	1,124	Greenwood	B 3
162	Chester	B 2	202	Griffithville	G 3
211	Chidester	D 6	178	Grubbs	H 2
2,037	Clarendon	H 4	296	Guion	G 2
1,456	Clarksville	D 3	1,264	Gurdon	D 6
164	Cleveland	E 3	363	Hackett	B 3
1,229	Coal Hill	C 3	257	Halley	H 7
197	Collins	G 7	1,787	Hamburg	G 7
2,794	Conway	F 3	353	Hampton	E 7
1,439	Corning	I 1	329	Hardy	H 1
894	Cotter	F 1	942	Harrisburg	I 2
1,081	Cotton Plant	H 4	1,602	Harrison	D 1
2,038	Crossett	F 7	1,780	Hartford	B 3
244	Cushman	G 2	621	Havana	C 3
136	Daisy	C 5	687	Hazen	G 4
231	Dalark	E 6	1,126	Heber Springs	G 2
803	Danville	D 3	10,796	Helena	I 4
1,757	Dardanelle	D 3	247	Hermitage	F 7
244	Datto, Clay	J 1	336	Higden	F 2
246	Decatur	B 1	192	Higginson	G 3

INCORPORATED CITIES, ETC.—Continued

Pop.			Pop.		
536	Holly Grove	H 4	355	Perryville	E 4
3,639	Hope	C 6	1,150	Piggott	J 1
605	Horatio	B 6	335	Pike City	C 5
17,238	Hot Springs	D 5	17,447	Pine Bluff	F 5
915	Hoxie	I 1	853	Plainview	D 4
131	Hudspeth	H 7	151	Pleasant Plains	G 2
380	Humphrey	G 5	495	Plumerville	E 3
508	Hunter	H 4	1,547	Pocahontas	H 1
1,700	Huntington	B 3	367	Portia	I 1
1,240	Huttig	F 7	823	Portland	G 7
600	Imboden	H 1	205	Pottsville	E 3
373	Jacksonport	H 2	191	Powhatan	H 1
114	Jamestown	G 2	774	Prairie Grove	B 2
242	Jasper	D 2	2,705	Prescott	D 6
88	Johnsville, Bradley	F 7	132	Princeton	E 6
7,123	Jonesboro	I 2	683	Pulaski Heights, Pulaski	F 4
746	Judsonia	G 3	471	Quitman	F 3
1,065	Junction City	E 7	65	Raggio City, Lee	I 4
175	Keo	G 4	175	Ratcliff, Logan	C 3
131	Kimberley, Pike	C 5	189	Ravenden Springs	H 1
445	Kingsland	F 6	214	Readland	H 7
362	Knobel	I 1	1,859	Rector	J 1
448	Lake City	I 2	278	Redfield	F 5
1,074	Lake Village	H 7	290	Reyno	I 1
520	Lamar	D 3	725	Rison	F 6
398	Leola	E 5	2,820	Rogers	B 1
154	Lepanto	J 2	320	Rosboro, Pike	C 5
1,898	Leslie	E 2	147	Russell	G 3
975	Lewisville	C 7	2,936	Russellville	D 3
292	Lincoln	B 2	459	St. Francis	J 1
57,343	Little Rock	E 4	159	St. Joe, Searcy	E 2
748	Lockesburg	B 6	430	St. Paul	C 2
303	London	D 3	2,331	Searcy	G 3
1,547	Lonoke	G 4	96	Sedgwick	I 2
193	Lowell	B 1	481	Sheridan	F 5
677	Luxora	K 2	251	Shiloh	F 3
637	McCrory	H 3	2,405	Siloam Springs	B 1
1,157	McGehee	H 6	185	South Bend	H 5
271	McNab	C 6	1,755	Springdale	B 1
482	McNeil	D 7	140	Springtown	B 1
988	Magazine	C 3	2,316	Stamps	C 7
216	Magness	G 2	396	Star City	G 6
2,045	Magnolia	D 7	572	Stephens	D 7
2,778	Malvern	E 5	465	Strong	F 7
817	Mammoth Spring	G 1	2,740	Stuttgart	H 6
562	Manila	J 2	379	Success	I 1
816	Mansfield	B 3	252	Sulphur Rock	H 2
4,810	Marianna	I 4	500	Sulphur Springs	B 1
2,026	Marked Tree	I 2	290	Swifton	H 3
780	Marmaduke	J 1	5,655	Texarkana	C 7
558	Marshall	E 2	611	Thornton	E 6
556	Marvel	I 5	180	Tillar	G 6
295	Maynard	I 1	222	Tontitown	B 1
282	Melbourne	G 1	228	Traskwood	E 5
3,953	Mena	B 5	583	Tuckerman	H 2
639	Midland	B 3	205	Tupelo	H 3
432	Mineral Springs	B 6	115	Ulm	G 5
251	Minturn	I 2	136	Umpire	B 5
559	Monette	J 2	52	Upland	E 7
95	Monte Ne	C 1	3,878	Van Buren	B 3
2,274	Monticello	G 9	920	Varner	G 6
2,424	Morrilton	E 3	149	Walcott	I 3
446	Mountain Home	F 1	597	Waldo	D 7
272	Mountain View	F 2	900	Waldron	B 4
10	Mount Nebo	D 3	1,798	Walnut Ridge	I 1
722	Mulberry	B 2	2,057	Warren	F 6
516	Murfreesboro	C 5	399	Washington	C 6
2,374	Nashville	C 6	232	Weiner	I 3
1,080	Nettleton	I 2	694	Wesson	E 7
595	Newark	H 2	116	West Point	H 3
3,557	Newport	H 2	330	Wheatley	I 4
612	New Rocky Comfort, Little River	B 6	42	Whitecliffs	C 6
397	Ogden	B 6	245	Widener	I 3
399	Okolona	D 6	929	Wilmar	G 6
516	Ola	D 4	622	Wilmot	G 6
1,769	Osceola	J 2	294	Wilton	B 6
129	Ozan	C 6	289	Winslow	B 2
1,146	Ozark	C 3	552	Womble	C 3
173	Palestine	I 4	2,353	Wynne	I 3
5,248	Paragould	I 1	463	Yellville	E 1
194	Paraloma	C 6	136	Youngstown, Lincoln	G 6
1,497	Paris	C 3	173	Zinc	E 1
383	Parkdale	H 7			

tion of slavery. There are still several large holdings in the cotton region. The average value per farm in 1910 was $1,864, the total value for the State being $400,089,303. The average value per acre of the farm is $14.38, but it varies greatly in different counties, ranging from $5 in some to $50 in others. The farms are equally divided between tenants and owners. However, 75.8 per cent of the land farmed by whites was in the hands of owners, while 54.4 of the lands operated by negroes was in the hands of tenants. The percentage of tenants is increasing. Twenty-two thousand three hundred and seventy-four farms were (1910) under mortgage.

Agricultural Products.— Agriculture is the leading industry and cotton is the chief product. The acreage devoted to cotton advanced steadily from 1870 to 1913, when it reached 2,502,000 and the product was 1,073,000 bales. The yield per acre is slightly above the average, as also the price. The former is due to the rich bottom lands, the latter to the superior grade of cotton, approaching the long staple variety. The low price in 1914 led to a regular campaign for diversified farming and the result was the product dropped to 785,000 bales in 1915. The same year the corn crop increased 20,000,000 bushels, or about 50 per cent and several other crops in like proportion, especially hay and oats. One of the most striking things is the development of the rice industry, which was introduced in 1904. In five years the acreage had risen to 27,419, in another five years to 100,000. The yield is 12 bushels above the average for the United States and the price 2.5 cents higher. The product in 1915 was 4,840,000 bushels worth $4,598,000. Cultivation is confined mainly to Lonoke, Prairie and Arkansas counties. Since 1909 Arkansas has risen from rank 13 among the States in production of apples to rank three, and from rank three in peaches to rank two. By far the larger part of the apples is grown in the three northwestern counties, the peaches in the western and southwestern counties below the Ozarks. One peach orchard in Pike County contains 5,000 acres, said to be the largest in the world. The berry crop is large in the eastern and central region. Large quantities of cantaloupes and strawberries are grown in the western counties, and strawberries in White County. The State ranked fourth in acreage devoted to vineyards (1915). The following table gives the amount and value of the chief products in 1916:

	Acreage	Production	Value
Cotton	2,635,000	1,145,000 (bales)	$107,430,000
Corn	2,550,000	45,135,000 (bu.)	44,232,000
Hay	375,000	469,000 (tons)	5,862,000
Oats	350,000	7,350,000 (bu.)	4,998,000
Rice	125,000	6,312,000	6,060,000
Potatoes	25,000	1,625,000	3,088,000
Wheat	255,000	2,040,000	3,325,000

The total value of the crops for 1916 was $175,057,000, an increase of $59,101,300 over that of 1915. More attention is being given to live stock and within the last few years there has been a notable improvement in the breed of cattle, yet the dairy industry, to which the State is so well adapted, is still in its infancy. In 1916 there were 1,589,000 hogs worth $8,581,000; 270,000 horses worth $22,140,000; 240,000 mules worth $24,480,000; 402,000 milch cows worth $15,276,000.

Forests and Forest Products.— The forested part of the State covers nearly three-fourths of its area. The area of national forest lands in 1916 was 916,919 acres. More than 100 varieties of wood are found, but only a few appear in considerable quantities. The leading variety is pine (chiefly short leaf yellow), which covers the southern part of the State. Several varieties of oak, hickory, ash, gum, maple and elm are scattered widely over the State. Cypress abounds in the swamps of the Saint Francis and Mississippi valleys. Red cedar and cotton wood are found in the Arkansas valley. The estimated stand of timber in 1909 was 81,600,000,000 board feet, which was exceeded by only two Southern States. Of this amount all but 2,900,000,000 was privately owned. All but 300,000,000 feet of this was in two National forests, the Arkansas, 680,000 acres, and the Ozark, 488,949 acres. In 1916, 240,000 acres in these forests were thrown open to homestead. Since 1909 the cut has amounted to about 14,000,000,000 feet, leaving 67,500,000,000 in 1916. In 1909, 2,060 mills were cutting 1,313,668,000 feet of pine, 358,556,000 of oak and other varieties in amounts bringing the total up to 2,111,300,000 feet worth $31,839,283. This does not include cross ties, poles, staves and firewood or whole logs shipped out of the State. Since 1909 the annual cut has decreased. In 1915, 1,150 mills produced 1,800,000,000 feet. A great part of this, both soft and hard, is dressed or used for manufactures within the State.

Manufactures.— Arkansas is still a distinctly agricultural State, but there is a steady increase of manufactures. The number of establishments rose from 1,746 in 1899 to 2,925 in 1909; the number of wage earners from 31,525 to 44,982; the value of the products from $39,888,000 to $74,916,000. The following table shows the standing of the leading industries in 1909:

	No. of establishments	Wage earners	Value of products	Value added by manufacture
Lumber and timber products, 1909	1,697	32,923	$40,640,000	$26,340,000
Oil, cotton seed and cake	44	1,086	7,789,000	1,784,000
Flour and grist mills	113	312	.5,615,000	756,000
Cars and shop work (R. R.)	16	3,249	4,154,000	2,395,000
Printing and publishing	295	981	2,082,000	1,546,000
Furniture and refrigerators	20	680	975,000	496,000
All others	740	5,751	13,661,000	6,664,000
Total	2,925	44,982	$74,916,000	$39,981,000

While in 1914 the number of establishments and wage-earners had decreased, capital invested, wages, and output had increased, as shown in the following table:

Number of establishments	2,604
Number of wage-earners	41,979
Capital invested	$77,162,000
Wages	20,752,000
Value of materials used	44,907,000
Value of products	83,940,000

The manufacture of lumber is easily the leading industry, employing 73.2 per cent of the wage earners and contributing over half to the value of products. While the number of

establishments is large compared with the amount of products the tendency toward large scale production is easily apparent. Of the 1,697 lumber and timber companies, 97 employed 17,300 wage earners and produced $22,848,000, while the other 1,600 employed 15,632 wage earners and produced $17,792,000. In the oil, cotton seed and cake industry 30 establishments employed 920 wage earners and produced $6,819,000 while 14 employed 166 and produced $969,000. The industries are centred mainly in five cities, Little Rock, Argenta, Fort Smith, Pine Bluff and Hot Springs. The legislature of 1915 passed a law requiring railroads to make repairs within the State.

Transportation and Commerce.— Though bountifully supplied with rivers the State has little water transportation of much value except that of the Mississippi. This stream gives deep water communication with other States and with the Gulf. New Orleans is the port for Arkansas and through this large quantities of lumber and cotton are exported. The Arkansas River is navigable a part of the year for boats of light draft from the eastern to the western border, a distance of about 400 miles, the White to Jacksonport, about 250 miles; also the Red and Ouachita for short distances, but the tonnage on all of them is very small. The main reliance is upon railroads. In 1861 railway construction had just begun. In 1870 there were only 256 miles in the State. By 1890 the mileage had risen to 2,203, in 1900 to 3,082 and in 1916 to 5,407, or one to every 10 square miles of territory. A railroad commission was created in 1909. Farmers still labor under great difficulties in getting their produce to the railroads. The State maintains a highway commission which aids counties and localities in construction of roads. There are about 36,500 miles of road in the State, of which 1,185 are improved. Seven lines of electric street railways operate 134 miles of track.

Banks.— There were 59 National banks in Arkansas (1915) with capital of $5,301,000; surplus and undivided profits, $3,331,121; resources, $34,641,315. There are 404 State banks (five private, 46 trust companies included), surplus and undivided profits, $5,457,353; capital, $13,763,892; resources, $61,989,094. Only seven National banks have ever failed in the State, two of these in 1915 (one of which was restored to solvency), and one in 1916. In 1915, five State banks failed, assets $78,450, liabilities $127,847. The office of State bank commissioner was created in 1913. There are very few savings banks separately organized, but most State banks run a savings department, paying 4 per cent. Their savings accounts amount to $3,719,007. There are 41 loan and trust companies, capital $4,741,875. Five private banks report $105,000 of capital.

Finances.— The assessed valuation increased from $299,730,877 ($199,331,562 real, $100,399,315 personal) in 1905, to $447,020,270 in 1915. A good part of the increase was due to the activity of the State tax commission, created in 1909. The total revenue collected in 1905 was $5,037,665; in 1915, nearly $7,000,000. The poll tax amounted to about $260,000, of which $190,000 is paid by whites. Another large item for non-property taxes was for liquor licenses. This amounted to $93,000 in 1913, $69,540 in 1914, $54,550 in 1915 and was entirely cut off by the "dry" law of 1916. The insurance companies paid $60,000 in fees and $112,412 in taxes. The return from the inheritance tax law was small, though the law is drastic in form. The only recognized bonded debt is that of $1,134,500 borrowed from the permanent school fund many years ago and $116,000 taken in like manner from the University endowment. On these the State pays 3 per cent. In 1917, the legislature authorized the issuance of $750,000, short term notes, to take up outstanding warrants of several years' accumulation. Education, Confederate pensioners, charitable institution and officers' and employees' salaries constitute the chief subjects for expenditures.

Education.— The educational conditions in Arkansas are not the best, neither are they the worst. A very decided improvement has been made in the last few years. In 1909 counties were authorized to elect superintendents and 25 counties now have this officer. In 1911 a State board of education (eight) was created with considerable administrative powers to be exercised with the State superintendent. Provision was made for the consolidation of weak districts and $50,000 was appropriated to aid high schools. The latter was declared unconstitutional in 1915 because the appropriation was made from the school fund. The legislature of 1917 provided aid for rural high schools, also funds necessary to receive the Federal grant under the Smith-Lever Act. A State supervisor of high schools, a State supervisor of rural schools and a school improvement organizer are supported by the general education board. A compulsory attendance law was passed in 1909 (amended twice since), but 28 counties are exempt and it is not well enforced. A child labor law was adopted by popular vote in 1914. State uniformity of textbooks was provided in 1917.

The school revenue is derived almost wholly from taxation. In 1907 the State levy was raised from 2 mills to 3 mills and school districts were authorized to vote 7 mills instead of 5. In November 1916, the people adopted an amendment raising the latter limit to 12 mills. The total expenditures in 1915 were $4,454,737 as compared with $3,187,083 in 1909 and $1,369,810 in 1900. The value of all school property in 1915 was $12,660,849 as compared with $6,939,000 in 1909 and $2,500,000 in 1900.

The census of 1910 showed 142,954 illiterates, or 12.6 per cent of the population, as against 20.4 per cent in 1900. The percentage for whites was 7.1, negroes 26.4 as against 11.6 per cent and 43 per cent in 1900. The percentage of illiterates 10 to 14 years of age was 8.2 per cent in 1910, 16.2 per cent in 1900. The school population in 1916 was 649,083, of whom 460,145 were white, 188,938 colored. The enrolment was 332,914 white, 114,812 colored, total 447,725. About 6,250 were enrolled in private schools. The percentage of the school population enrolled in the public schools is higher than in any State east of the Mississippi. The average length of the term is 134.9 days, the average daily attendance 304,401. The average salary of teachers is $51.50, or about $325 a year; $65 monthly for male teachers, $50 for female teachers. The number of teachers was, male, 4,982; female, 6,080. Arkan-

sas ranks first in the percentage of revenue paid to teachers. There are 145 schools giving high school instruction, but only 82 maintain a four years' course. The enrolment in public high schools is 9,505, private 1,356. Four agricultural high schools (at Jonesboro, Russellville, Magnolia and Monticello) and one normal (at Conway) are supported out of the general revenue. Also a "Branch Normal" for negroes at Pine Bluff. The University of Arkansas (Fayetteville 1872) has a total annual revenue of about $300,000. In 1917, it was put on a millage basis. The enrolment is about 800. A medical department at Little Rock was added in 1911. Besides these there are the following private institutions: Arkansas College (Presbyterian, Batesville 1872); Hendrix College (Methodist, Conway 1884); Ouachita College (Baptist, Arkadelphia 1886); Henderson-Brown (Methodist, Arkadelphia 1890); Arkansas Cumberland College (Presbyterian, Clarksville 1891); Galloway Female College (Methodist, Searcy); Central Baptist College for Women (Conway); and Crescent College (Eureka Springs).

Churches.— The Baptists and Methodists are the leading denominations in membership and influence. Catholics, Disciples of Christ, Presbyterians and Episcopalians have growing memberships in the order given.

Charitable and Penal Institutions.—There are 27 benevolent institutions in the State. The following are maintained by the State in or near Little Rock: School for the blind, school for deaf mutes, hospital for nervous diseases, reform school and home for Confederate soldiers. The State also pays $1,000,000 a year in pensions to ex-Confederates. The tuberculosis sanatorium is located at Booneville. The State prison is located at Little Rock, the State penal farm for whites in Jefferson County, for negroes in Lincoln County. At the last census the number of dependent paupers was 534, or 33.9 per 100,000 of the population. Criminals amounted to 1,307, or 83 per 100,000 of the population.

Population.— The growth of population is indicated by the following figures: 1820, 14,270; 1830, 30,388; 1840, 97,574; 1850, 209,897; 1860, 435,450; 1870, 484,471; 1880, 802,525; 1890, 1,128,179; 1900, 1,311,564; 1910, 1.574,449; 1916 (est.), 1,753,033. The State lost heavily to Oklahoma when that State was opened to settlement. Of the total population, 71.8 per cent are whites, 28.1 per cent are colored. In 14 of the 75 counties over half the population are colored, but in 26 counties the whites make up 95 per cent. The foreign population is 16,909 or 1.4 per cent, though native whites of foreign parentage make up 2.3 per cent. Of these the Germans contributed 34.4 per cent. In 1910 there were only 28 incorporated places of more than 2,500 population and these contained only 12.9 per cent of the total population. There were 395,842 males, 21 years of age in 1910, and 263,055 qualified voters (who had paid the poll tax) in 1915. The leading cities are Little Rock, 45,941; Fort Smith, 23,975; Pine Bluff, 15,102; Hot Springs, 14,434; Argenta 11,138.

Government.— The constitution, in effect since 1874, has undergone few material changes. Suffrage depends on a year's residence and the payment of a poll tax. The Governor and other State officers hold office for two years. The salary of the Governor is $4,000 a year plus $1,000 for house rent. His veto may be overridden by a simple majority. He has an extensive power of appointment. If the office becomes vacant within the first year, a new election is held; if later, the President of the Senate fills out the term. The legislature meets biennially. The members of the House of Representatives (100) are elected every two years, of the Senate (35) for four. The per diem ($6) is limited to 60 days, after which the legislature may sit without pay. Special sessions are limited to 15 days. The Supreme Court has five members elected for eight years. There are 18 circuit and 12 chancery courts; also municipal courts and the usual county and probate courts and justices of the peace. Three cities have commission government, one the city manager. There is an optional primary election law. A corrupt practices act applies to all elections.

The following is a list of Territorial and State governors to date:

TERRITORIAL

James Miller	1819–25
George Izard	1825–29
John Pope	1829–35
William S. Fulton	1835–36

STATE

James S. Conway	Democrat	1836–40
Archibald Yell	"	1840–44
Samuel Adams	"	1844
Thomas S. Drew	"	1844–48
John S. Roane	"	1848–52
Elias N. Conway	"	1852–60
Henry M. Rector	"	1860–62
Harris Flanagan	"	1862–64
Isaac Murphy	Republican	1864–68
Powell Clayton	"	1868–71
Ozro A. Hadley	"	1871–72
Elisha Baxter	"	1872–74
Augustus H. Garland	Democrat	1874–77
Wm. R. Miller	"	1877–81
Thomas J. Churchill	"	1881–83
James H. Berry	"	1883–85
Simon P. Hughes	"	1885–89
James P. Eagle	"	1889–93
William M. Fishback	"	1893–95
James P. Clarke	"	1895–97
Daniel W. Jones	"	1897–01
Jeff Davis	"	1901–07
John S. Little	"	1907–09
George W. Donaghey	"	1909–13
Joseph T. Robinson	"	1913
W. K. Oldham	"	March 8–23
J. M. Futrell	"	March 23–Aug. 6
G. W. Hayes	"	1913–17
C. H. Brough	"	1917

State Militia.— There are 24 companies with 1,850 enlisted men (June 1916).

Representatives in Congress.— There are two senators and seven representatives.

Politics.— The State has been democratic since 1874, generally by large majorities and a solid delegation in Congress.

History.— De Soto was the first white man to set foot in the State; the French explorers, Marquette and Joliet, came down the Mississippi in 1673 and found near the mouth of the Arkansas river a tribe of Indians, the Arkansas, from whom the State and river were named. The first settlement was made under direction of De Tonti at Arkansas Post in 1686 a few miles above the mouth of the Arkansas river. But settlement was slow and inhabitants were very few in 1803 when the United States acquired the territory as a part of Louisiana. In 1812 it was separated from Louisiana as a part

of Missouri. In 1819 Arkansas Territory, including what is now Oklahoma, was organized. It was admitted as a slave State 15 June 1836. Though settled chiefly by the southern people it was greatly divided on the question of secession and the convention adjourned without passing an ordinance, but President Lincoln's call for troops led to the reassembling of the convention and the ordinance of secession was adopted 6 May 1861. Several battles took place in the State, but it did not suffer from military operations like the others. By 1863 a large part of the State had been recovered by the Union and a loyal State government was established in 1864, with Isaac Murphy, governor. However the State had to undergo reconstruction and was not readmitted to the Union until 23 June 1868. The anarchy of the carpet-bag régime reached its climax in 1872 in an armed conflict between Brooks and Baxter for the governorship. The Democrats supported Baxter, Republican, and he held until 1874. A new constitution was adopted that year and the Democrats recovered the State government, which they have held ever since.

The constitution of 1874, which was somewhat reactionary in type, is still in force, though 13 amendments have been added. The most radical is that providing for the initiative and referendum (1910). In recent years the legislature has passed some progressive and a few radical measures. The attempt to regulate freight and passenger rates on railroads (1907) was taken into the Federal courts, along with like attempts in Minnesota and Missouri. After a long delay the action of the State was sustained in part, but soon overruled by new suits and decisions. A drastic anti-trust act (1905) drove the insurance companies and some other concerns out of the State for a while, but it was amended and the companies returned. The 'fellow servants' rule was abolished after a long drawn-out fight. The convict lease system has been greatly improved and virtually abolished. The legislature of 1915 passed a State-wide prohibition law, though a similar law originated by petition had been rejected in 1912, a drastic inheritance tax law, and a minimum wage law. In 1917 the ballot was conferred on women in primary elections; the tax laws were revised; an amendment was submitted authorizing the State to issue $9,000,000 of bonds to loan to farmers for the purchase of lands; and a convention was called to revise the constitution. The convention met, appointed committees, and adjourned to July, 1918.

The first opportunity to use the initiative and referendum came in 1912. One legislative act was referred by petition and three other acts originated under the initiative. The first was a revenue law, the others related to prohibition, elections and uniform and free textbooks. All were rejected. Five amendments were voted on, two submitted by the legislature and three under the initiative. One, the "grandfather clause," was defeated. All the others received a majority of the votes cast on them, but the Supreme Court held that only three could be submitted at one time and that a majority of the total vote cast was required for adoption. This cut out all initiated amendments except the one limiting the legislature to 60 days. In 1914 two acts were submitted under the initiative, a child labor law after the preceding legislature had refused to pass one, and a "publicity" act, which subsidizes the press through public advertising. Both were adopted. An amendment (by petition, 1916) providing for good roads received a majority of the vote cast on it, but not a majority of the total vote. A primary election law, the repeal of the prohibition law and two amendments originated by petition were submitted in 1916. The first was adopted. Also the amendment raising the limit of the school tax to 12 mills. The others failed.

Bibliography.—'The South in the Building of the Nation' (Vols. III, V, VI, Richmond 1909); Publications of the Arkansas Historical Society (3 vols., Fayetteville 1906–); Harris, Maxwell and Keifer, 'Wood Using Industries and Natural Forests of Arkansas' (U. S. Forest Service Bulletin, No. 106, 1912); U. S. Geological Survey, Mineral Resources; Publications of the State Geological Survey, Branner, Purdue, Steele (Fayetteville); Reports of the Secretary of State, the Auditor and Superintendent of Public Instruction (Little Rock).

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ARKANSAS, University of, a State institution founded in 1871 at Fayetteville, Ark. It comprises a college of liberal arts and sciences, colleges of engineering and agriculture, an agricultural experiment station and a department of education. The medical and law faculties are located at Little Rock and at Pine Bluff there is a branch normal college for negroes. The annual income is about $250,000, derived from Federal and State endowments and appropriation. The university plant and grounds are valued at more than $1,000,000. The library contains 25,000 volumes. The State appropriates $20,000 annually to the medical school. Tuition is free in all departments except in the professional schools. In 1917 the institution had 70 instructors and 814 students.

ARKANSAS CITY, Kan., city of Cowley County, 50 miles southeast of Wichita, near the southern border of the State, on Arkansas River, near the Walnut River, and furnished with water power by a canal uniting them. It was settled as Greswell in 1870, and incorporated under its present name in 1872. It is on the Atchison, Topeka and Santa Fe, the Missouri Pacific, the St. Louis and San Francisco, the Midland Valley and Kansas S. W. railways, and manufactures agricultural implements, windmills, wire mattresses, flour and lumber. The new western oil fields around have added largely to its prosperity and it has a large trade with Indian posts and agencies in Oklahoma and Indian Territory. It contains a United States Indian School; operates municipal water works; and since 1912 is governed by commission. Pop. 8,500.

ARKANSAS POST, Ark., village in Arkansas County; on the Arkansas River, 117 miles southeast of Little Rock. It is on a high bluff and was the site of the first settlement made within the present limits of Arkansas by French missionaries in 1685. Its elevated location gave it considerable military importance during the Civil War. The Confederates established strong works here, which were re-

duced by a combined assault of a portion of the Federal army, under General McClernand, and a naval command under Admiral Porter, on 11 Jan. 1863.

ARKANSAS RIVER, the largest affluent of the Mississippi save the Missouri; length, nearly 2,000 miles; area of basin, 189,000 square miles; mean discharge, 63,000 cubic feet. It rises in central Colorado; flows east with a rapid current through deep, narrow cañons, and over a rocky bed till it emerges on the naked, arid plains of eastern Colorado and western Kansas; runs east several hundred miles in Kansas, and turning southeast leaves it near Arkansas City. It then cuts a cantle off Oklahoma,—where it receives the Cimarron and the broad shallow Canadian from the west, with the Verdigris and Neosho from the north,—and becomes navigable 650 miles to its mouth in Arkansas (which it bisects). In Fremont County, Colo., it flows through the Royal Gorge, one of the deepest cañons in the United States.

ARKANSAS STONE, a name given to the oilstones made from two grades of novaculite quarried in Hot Springs, Garland County, and also in adjoining counties in Arkansas. The rocks cover a large area and yield the finest whetstones. From them the highest grades of both whetstones and razor hones are made.

ARKLOW, Ireland, seaport town of county Wicklow, 14 miles southwest of the town of that name, on the right bank and just above the mouth of the Avoca, here crossed by a bridge of 19 arches. Fishing is the chief industry, gunpowder is manufactured, and copper and lead are exported. There are remains of an old monastery, and of the castle of the Ormonds, the latter destroyed by Cromwell in 1649. Here in 1798 the United Irishmen suffered a defeat. Pop. 5,000.

ARKONA, the northeast promontory of the German island of Rügen, in the Baltic. Its chalk cliffs rise to a height of 177 feet, topped with a lighthouse, built in 1827, from which the Danish island of Möen, 33 miles northwest, can be seen. Here stood the famous fortification (Slavonic, *Urkan*) so long impregnable, and the temple of the Wend deity Swantewit, the most sacred sanctuary of the Slavs of northern Germany.

ARKOSE, är-kōs′, a variety of sandstone that contains many fragments of feldspar. Arkose commonly results from the incomplete, or mechanical weathering of a granite, so that the grains of quartz and feldspar fall apart into what is called a feldspathic sand or arkose sand. The feldspar grains remain unweathered. This type of weathering is common where frost or great heat without much moisture is the agent, as on high mountains or in deserts. By cementing together of this feldspathic sand an arkose results.

ARKWRIGHT, Sir **Richard,** English inventor: b. Preston, Lancashire, 23 Dec. 1732; d. 3 Aug. 1792. He was the youngest of 13 children, and was bred to the trade of a barber. His residence in a cotton-spinning district (Bolton) drew his attention to the operations of that manufacture; but he was 35 before he devoted himself to consideration of the subject. The *spinning-jenny,* invented in 1767 by Hargreaves, gave the means of spinning 20 or 30 threads at once with no more labor than had previously been required to spin a single thread; but the thread spun by the jenny, could not, however, be used as warp, being destitute of the firmness required. Arkwright supplied this deficiency by the invention of the *spinning-frame,* which spins a vast number of threads of any degree of fineness and hardness, leaving the operator merely to feed the machine with cotton and to join the threads when they happen to break. His invention introduced the system of spinning by rollers, the carding or *roving* as it is technically termed (that is, the soft, loose strip of cotton) passing through one pair of rollers and being received by a second pair, which are made to revolve with three, four or five times the velocity of the first pair. By this contrivance the roving is drawn out into a thread of the desired degree of tenuity, a twist being given to it by the adaptation of the spindle and fly of the old flaxwheel to the machinery. The precise date of his invention is not known, but it is most probable that the idea of spinning by rollers had occurred to his mind as early as the period when Hargreaves was engaged in the invention of the jenny. He removed to Nottingham in 1768, in order to avoid the attacks of the lawless rabble who thought his machines would deprive many workmen of a livelihood. Arkwright erected his first mill, which was driven by horses, at Nottingham, and took out a patent for spinning by rollers, in 1769. He built a second factory on a much larger scale at Cromford, in Derbyshire, in 1771, the machinery being turned by a waterwheel, and having made several additional discoveries and improvements, took out a fresh patent for the whole in 1775, thus completing a series of ingenious and complicated machinery. When the importance of his inventions became known efforts were made to have the patent set aside, and in 1781 Arkwright brought actions against a number of persons for invading his patent. Only one cause was tried, that against Colonel Mordaunt in the Court of King's Bench in July 1781; and in that the verdict went against Arkwright on the ground of defective specification. In February 1785, a second action was tried in the court of common pleas, in which Arkwright brought a number of persons to prove that they could make machines from his specifications, in consequence of which he obtained a verdict in his favor. This producing great alarm among many who had erected machines for cotton spinning, and from whom a royalty was demanded, in order to settle the dispute a suit was brought against Arkwright in the Court of King's Bench, in which the whole question was argued, not only as to the intelligibility of his specification, but on the less technical and more important ground of his not being himself the inventor of the machines for which he had obtained a patent. After a long and ably-conducted trial a verdict was given against Arkwright, and in November 1785 the patent was canceled. None of Arkwright's most intimate friends, or those best acquainted with his character, ever had the slightest doubt with respect to the originality of his invention. In 1786 Arkwright received the honor of knighthood from George III, and unlike many inventors, he amassed a large fortune

by his inventions. Consult Baines, 'History of Cotton Manufacture' (London 1861), and Ure, 'The Cotton Manufacture of Great Britain' (London).

ARLBERG, a mountain pass between the Rhætian and the Lech Alps, in the west of Tyrol; between Tyrol and Vorarlberg, pierced by one of the longest railway tunnels in the world. It is six and one-half miles long, was finished in November 1883 and connects the valley of the Inn with that of the Rhine, and the Austrian railway system with the Swiss railways. In 1786 a road was constructed across the pass and was for a long time the only means of communication between Vorarlberg and the rest of the country.

ARLES, ärl, (ancient, *Arelate*), France, town on the Rhone, about 25 miles from its mouth, in the department of Bouches-du-Rhône. A canal has been cut which connects it with the Mediterranean. It stands on a rocky limestone eminence, sloping to the river, and has irregular streets, presenting many interesting features. In a large square is an ancient granite monolith, and among other remarkable objects are the Romanesque cathedral of Saint Trophimus, with a fine portal and some good paintings and sculptures; and especially numerous ancient remains, of which the most conspicuous are those of a Roman amphitheatre which accommodated 24,000 spectators, and those of a Roman theatre. It has railway workshops, manufactures silk, hats, flour, etc., and forms a market for the productions of the surrounding country. It possesses a college, a naval school, a public library and several museums. Arles was founded several centuries before the Christian era and was the chief colony of Massilia (Marseilles). In the 4th and 5th centuries several church councils met here. From 897 to 1150 it was the capital of a kingdom bearing its name. Pop. (1911) 16,746.

ARLINGTON, Mass., town in Middlesex County, about seven miles northwest of Boston, on the Boston & Maine Railroad. It contains several fine buildings, among which is a library given to the town by Mrs. Eli Robbins at a cost of $200,000. The town has electric lights and car service to Boston, of which it is practically an attractive residential suburb. Local industries include flower and market gardening, chrome works, piano case and wire factories. The United States census of 1914 recorded 19 manufacturing establishments of factory grade, employing 303 persons, of whom 246 were wage earners, receiving a total of $185,000 annually in wages. The capital invested amounted to $1,056,000 and the year's output was valued at $641,000. As Menotomy, Arlington was settled about 1650; in 1807 it was renamed West Cambridge, and received its present name in 1867. Pop. 12,000.

ARLINGTON, Wash., town in the northern part of Snohomish County, at the confluence of the forks of the Stilliguamish River, and on the Northern Pacific Railroad, 60 miles north of Seattle and 22 miles northeast of Everett, the county-seat. It has saw mills, a shingle mill, a creamery and pasteurizing plant, cannery, machine shops, blacksmith and carpenter shops, two banks, a post-office, two hospitals and a weekly newspaper. It has a graded school system, with a fully accredited high school, and six churches representing the leading denominations. The principal agricultural industries are dairying, grain-growing, bush-fruit growing, etc. Poultry raising is also important. The lumber industry is extensive. The two banks have resources aggregating $600,000. The assessed valuation of the town is $450,000, said to represent but 33 per cent of the actual value. The annual expenses amount to about $8,000, of which about $1,000 are raised otherwise than by direct taxes. The government is vested in a mayor and council. Pop. 1,500.

ARLINGTON CONFEDERATE MONUMENT ASSOCIATION. During the administration of President McKinley the Confederate dead buried in the city of Washington, D. C., and vicinity were removed to the National Cemetery at Arlington, Va., the old home of Robert E. Lee, where they were reinterred in a plot of ground set apart by the President for that purpose and designated "The Confederate Section." The Arlington Confederate Monument Association was formed for the purpose of erecting in this section a suitable monument to the dead there buried and to stand, in a larger sense, as a memorial to all those who lost their lives in defense of the Confederacy, as well as to the cause they represented.

ARLON, är'lôn, Belgium, the capital of the province of Luxembourg, in the midst of the woods and mountain ridges of the Ardennes. It is a thriving place, with manufactures of ironware, leather, tobacco, earthenware and clay pipes. It appears in the Antonine Itinerary, and from the coins, inscriptions and other antiquities found, must have possessed some importance even in the time of the Romans. It is mentioned under its present name in 870, in connection with the partition of Lorraine. It has suffered much in the various wars which swept across this part of Europe. From 1684 to 1697 it was in the hands of the French. It was ceded to Belgium in 1831. Pop. (1910) 12,012.

ARM, a term technically applied to that portion of the upper extremity of the body extending from the shoulder joint to the elbow, but popularly used to denote both arm and forearm. The arm proper has one large and strong bone, the humerus, covered by strong muscles, which protect the blood vessels and nerves. The upper end of the humerus fits into the head of the scapula and with the clavicle forms the shoulder joint. The head of the humerus is held in the joint partly by ligaments, but mainly by the muscles attached to it. The motions of the arm are many. Those muscles that move the arm inward toward the chest are known as the abductors. These are the pectoralis major, coraco brachialis, which also flex the arm, and the latissimus dorsi and teres major, which also extend the arm. The arm is moved away from the body by the deltoid, a large muscle on the outer side, and the supraspinatus, a smaller muscle going from the scapula. The arm is rotated outward by the infraspinatus and the teres minor, and rotated inward by the subscapularis: All of these muscles are fastened about the upper part of the humerus. The greater mass of the muscles of the arm are those that go to the forearm and that move

SIR RICHARD ARKWRIGHT

Famous for Inventions in Cotton Spinning

that member. Those that flex the forearm, or bend the elbow, are the biceps, the brachiates and the brachio-radials, the former being the most important. It also aids in turning the forearm palm downward. The muscles that extend or stretch the forearm are the triceps and the anconeus. There are other movements of the forearm. The arm having two bones, the radius and ulna, one turns on the other and the movements of pronation and supination are produced. Pronation is accomplished by two muscles, the pronator teres and the pronator quadratus; the supinator makes the movement outward. The movements of flexion and extension take place in the elbow joint, which is hinged like those of pronation and supination, just below the elbow joint, the radius moving on the ulna. The union of the radius and ulna with the bones of the wrist make a hinge-like joint, the wrist joint. Movements at the wrist are in four directions, flexion and extension, abduction and adduction. These movements, as well as those of the fingers, are made by a large group of muscles some 20 in number. There are in all 48 muscles concerned in the movements of the arm, forearm and hand. The blood supply of the arm is derived from the brachiocephalic of the right side and from the arch of the aorta on the left (see AORTA) in a single main trunk that divides at the bend of the elbow. The first portion is called the subclavian and is not in the arm proper; the axillary, or second portion, begins at the outer border of the first rib and becomes the brachial just about the armpit where it may be felt and compressed. The brachial artery is the great trunk of the arm. It may be felt just inside the inner edge of the biceps muscle about the middle and there may be readily compressed in case of hæmorrhage. At the bend of the elbow the brachial artery divides into the radial and ulnar, which supply the outer and inner sides of the forearm respectively. The radial artery is the one most frequently felt in determining the pulse; the ulnar may be used but as it lies deeper it is felt less easily. In the hand these arterial branches anastomose to form a superficial and a deep palmar arch from which branches go to supply the fingers. Hæmorrhages in the palm of the hand can be controlled therefore only by controlling both radial and ulnar arteries, or better by controlling the brachial just above the bifurcation in the elbow. This may be done by strongly flexing the forearm or by something held against the artery. The principal veins of the forearm are the ulnar, the median and the radial; of the arm the cephalic and basilic. These empty into the axillary vein and this into the sub-clavian. The nerve supply of the arm is derived from the spinal cord from the fifth, sixth, seventh and eighth cervical, and the first, second and third thoracic nerves. These form a complex plexus, the brachial plexus. The main branches going to the different muscles and supplying the skin areas are the median, ulnar, musculo spiral, musculo cutaneous and circumflex. Their distribution is exremely complex. See JOINT, DISEASES OF.

ARMADA, är-mä'dą or är-mä'dą, the Spanish name for any armed force, especially a naval force. The term *Spanish Armada* is applied to that great naval armament which Philip II, in 1588, fitted out under the command of the Duke of Medina-Sidonia and Martinez de Recaldo, against Queen Elizabeth, with the view of conquering England. The fleet consisted of 131 great and many smaller ships of war, and carried 19,000 marines and 8,000 sailors. The ships had scarcely left Lisbon on 29 May 1588 when they were scattered by a storm and had to be refitted in Corunna. Advancing in the form of a half-moon of seven miles in extent, it came in sight, off Plymouth, of the English fleet, scarcely numbering 80 sail, and commanded by Lord Howard, who, endeavored by dexterous seamanship and the discharge of well-directed volleys of shot at alternately long and short distances, to damage the vessels of the enemy. Some of these, including the galleon laden with treasure, fell into the hands of the English or were destroyed. Arrived at length off Dunkirk, on the 7 August the armada was becalmed and thrown into such confusion by the arrival in the fleet of eight fire-ships sent by the English admiral, that on the morning of the 8th Lord Howard was enabled to attack it on several sides. Notwithstanding a brave resistance, many of the Spanish vessels were destroyed or fell into the hands of the English and Dutch, and in consequence the Duke of Medina-Sidonia resolved to abandon the enterprise, conceiving the idea of conveying his fleet to Spain by a voyage round the north of Great Britain. A hurricane which now broke forth with tremendous violence on the already dispirited Spaniards, scattered their ships in all directions. Some went down on the cliffs of Norway, others in the open sea and still others on the Scottish coast. About 30 vessels reached the Atlantic Ocean, and of these several were driven by a west wind on the coast of Ireland and wrecked. In all, the armada is said to have lost in the open sea 72 large vessels, exclusive of smaller craft, and 10,185 men, while every family of distinction in Spain had to mourn the loss of one or more of its members. Only about 50 vessels reached Spain on the return voyage.

Bibliography.— Corbett, 'Drake and the Tudor Navy'; Creasy, 'Fifteen Decisive Battles'; Froude, 'The Spanish Story of the Armada' (London 1892); Gardiner, 'Historical Biographies: Drake'; Green, 'History of the English People'; Motley, 'History of the United Netherlands'; Laughton, J. K. (ed.), 'State Papers Relating to the Defeat of the Spanish Armada' (London 1894).

ARMADALE, the title of a novel by Wilkie Collins (1866). The plot of this, like that of 'The New Magdalen' and others of its author's later novels, is a gauntlet of defiance to the critics who had asserted that all the interest of his stories lay in the suspension of knowledge as to the dénouement. The machinery is in full view, yet in spite of this disclosure, the reader's attention is held until he knows whether the villain or her victims will come out victorious.

ARMADILLO (Sp. dim. of *armada,* armed, referring to its bony shell). 1. *A. edentate,* mammal of the family *Dasypodidæ,* found in South and Central America and notable for its defensive armor. This armor consists of small roundish bony plates, ossified within the skin, and united to form solid shields, one over the shoulders, one over the haunches, and, between these two, tranverse bands of movable plates, which protect, but

leave freedom of motion, to the trunk of the body. These plates are overlaid by a thin, horny pellicle, and between them grow hairs varying in length and amount with the species, from almost none in some to a coat in others, hiding the shell; and the unarmored central surface is also hairy. The head is provided with a shield entirely separate from that of the shoulders, and in some species even the tail is protected by bands of plates. The various forms of armadillos are distinguished largely by the number of movable thin bands of plates lying between the large fixed anterior and posterior shields, up to as many as a dozen in the cabassous (*Xenurus*). This armor serves the purpose of defense, and some of the tribe (only those of the genus *Tolypeutes*, however), increase its value by exercising the power of rolling themselves up into a ball so that the tender under parts of the body may be completely protected. This ability depends upon the number of bands in the central portion of the armorcase. Although true edentates, these animals have a few small, useless teeth, without true roots; the tongue is covered with a sticky fluid like that secreted by the tongue of an ant-eater, but it is not protrusile.

The armadillos are timid, nocturnal animals, living on insects, carrion and vegetable matter; their legs and claws are adapted to burrowing, and, when pursued, they usually bury themselves more quickly than the pursuer can follow them. Only one species (*Dasypus villosus*) is sufficiently adaptable to hold its own when a wild region is settled; the others soon disappear. One of the most interesting of them all is the pichichago (*Chlamydophorus truncatus*), found in Argentina, which lives entirely underground like a mole, and exhibits a peculiar structure in many ways, the body having an appearance of truncation, as if the hinder part had been cut squarely off, instead of ending in curved lines. It is very small, only five to six inches long, while the giant armadillo (*Priodon gigas*) measures three feet, exclusive of the tail. Some of the armadillos range north and south as far as Texas and Argentina; among these is the peba, or nine-banded armadillo (*Tatusia novemcincta*). The family is divided into several genera and the species are numerous and are known as peludos, cabassous, apars, etc., elsewhere described. They are eaten by the South Americans and even esteemed delicate, but their flesh is usually so flavored by the insects and decayed matter which they eat that only a few vegetable-eating species are inoffensive to an unaccustomed palate.

Many forms of fossil armadillos are known from both North and South America, a fossil species of Dasypus having been six feet long. Another genus was *Eutatus*, which had a shield formed of 36 distinct bands, of which the last 12 were soldered together. These lead back to the large group *Gravigrada*. (See GLYPTODON; MYLODON.) Good accounts of the armadillos are given in both the 'Standard' and the 'New (Royal)' Natural Histories. Consult also Hudson, 'Naturalist on the La Plata' (1892); Alston's 'Biologia Americana Central'; 'Mammals', (1879–82), with colored plates; Azara's 'Historia Natural de los Paxaros del Paraguay' (Madrid 1805); 'Mammals of Uruguay' in the *Proceedings* of the Zoological Society of London for 1894; Newman 'The American Naturalist' (September 1913).

ARMADILLO, in entomology. See WOOD-LOUSE.

ARMAGEDDON, ăr'mą-gĕd'dŏn, the great battlefield where occurred the chief conflicts between the Israelites and their enemies. The name was applied to the tableland of Esdraelon in Galilee and Samaria, in the centre of which stood the town Megiddo, on the site of the modern Lejjun; used figuratively in the Apocalypse to signify the place of "the battle of the great day of God." From the applications of the word Armageddon to the great battle at the end of time it has come to be used for any great slaughter or conflict.

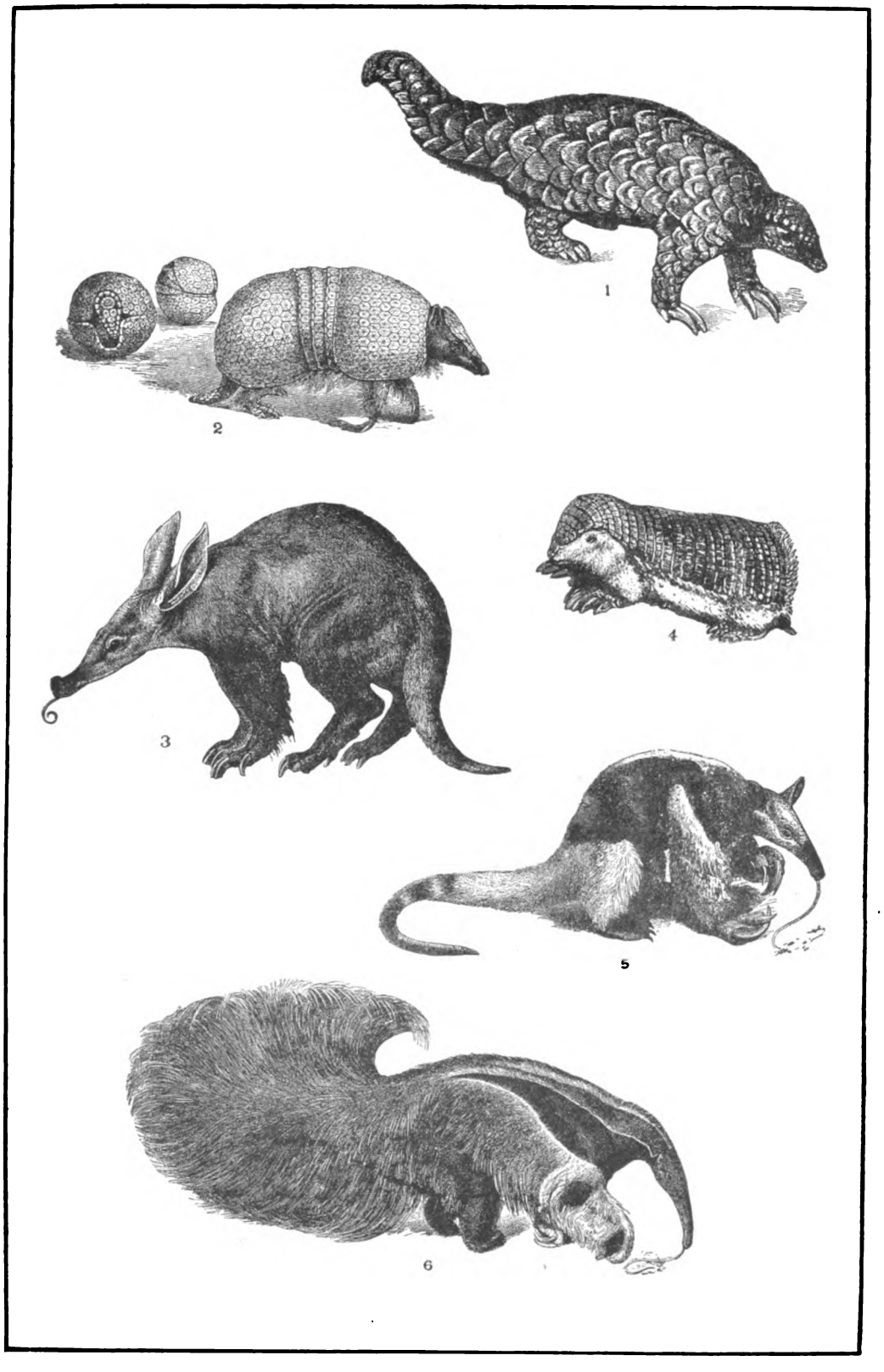
ARMAGH, ăr-mā', Ireland, a county in the province of Ulster. Its area is about 500 square miles. The northern part of the county, bordering on Lough Neagh, consists principally of extensive bogs of great depth, with a remarkably black soil. Oats, potatoes, wheat, fruit, flax and turnips are the principal crops. Cattle, hogs and sheep are raised. The manufacture of linen is carried on very extensively. The chief towns are Armagh, Lurgan, Portadown. Armagh is the county town. Pop. (1901) 125,238; (1911) 120,291.

ARMAGH, Ireland, city and capital of the county of Armagh. It contains two cathedrals, a Protestant and a Roman Catholic; county court-house, prison, infirmary, lunatic asylum, linen hall, music hall, a public library and an observatory. In the Middle Ages Armagh was an extensive and populous city, and celebrated for its learning, having at one period 7,000 students at its college. There is a modern college, a barracks, an observatory and a large library. Among its benevolent institutions are an infirmary, fever hospital and lunatic asylum. Linen weaving is the chief industry. Not far from Armagh was the palace of Emania, the royal residence from the 5th to the 9th century. Between 839 and 1092 the Danes sacked the town five times. Armagh was again a battleground in the religious struggle between the English and Irish. Pop. (1911) 7,356. Consult Stuart, J., 'Historical Memoirs of Armagh' (Dublin 1900).

ARMAGNAC, ăr'mą-nyąk', **Counts of,** an ancient French family, said to have sprung from a branch of the Merovingians. Many of its members hold a prominent place in the history of France. One of the most celebrated was Bernard VII, son of John II, surnamed the Hunchback. He succeeded his brother, John III, in 1391, and greatly extended his territories by the most unscrupulous means, putting several of his relations to death because they stood in the way of his ambitious schemes. Another of the family, John V, grandson of the above, who succeeded his father, John IV, in 1450, made himself notorious for his crimes. On a pretended dispensation from the Pope he married his own sister, by whom he had three children. Charles VII took his possessions, but they were restored by Louis XI. By joining the "League for the Public Weal" he was driven into Aragon and had his estate forfeited. Armagnac was slain by the King's soldiers.

ARMAGNAC, the title of a former district of France now included in the department

ARMADILLOS AND ANT-EATERS



1 Pangolin (Manis pentadactyla)
2 Three-banded Armadillo (Tolypeutes tricinctus)
3 Aard-Vark (Orycteropus afra)
4 Pichiciago (Chlamydophorus truncatus)
5 Tamandua (Tamandua tetradactyla)
6 Great Ant-Eater (Myrmecophaga jubata)

of Gers. Its inhabitants figured largely in the wars of the Middle Ages, one of their contests being known as the "Armagnac War," in which the Armagnac mercenaries of the Emperor Frederick III were defeated by the Swiss, 26 Aug. 1444. See Berthault's 'L'Armagnac' (1899).

ARMAGNAC WAR, The, (*Bellum Armeniacum;* in German called frequently *Armegeckenkrieg*), the struggle between the Swiss and the Armagnac mercenaries of Frederick III in 1444. The war was concluded by the defeat of the Armagnacs at Saint Jacob on the Birs 26 Aug. 1444. See ARMAGNACS, THE.

ARMAGNACS, The, mercenary bands, derived chiefly from the district of Armagnac in southern France, and largely trained in the army recruited in 1410 by Count Bernard of Armagnac for his contest with the Duke of Burgundy. They made themselves extremely oppressive in France through their plundering; and when the Emperor Frederick III requested auxiliary troops from Charles VII, to assist in the conquest of the Swiss, the latter gladly dispatched the Armagnacs. Doubtless the King believed he might at the same time be able to gain control of territory on the left bank of the upper Rhine. What is known as the Armagnac War ensued. In Germany the word Armagnac was converted into *armer Geck* ("poor fool"), and the war frequently styled *Armegeckenkrieg.* On band of 20,000 Armagnacs proceeded by way of Lorraine, another of 30,000 to southern Alsace, whence it marched against the Swiss. At Saint Jacob on the Birs, 26 Aug. 1444, it was badly defeated, with a loss of 6,000, by 2,000 Swiss. It then retired to Alsace, and on 28 October a treaty (that of Ensisheim) was concluded between France and the Swiss Confederation. The Armagnacs continued for a time to work havoc in Alsace and Swabia, where the peasantry retaliated by condemning to death an Armagnac whenever they caught one. In 1445 the remnant was in part dismissed by Charles VII, in part incorporated with other companies of soldiery. Consult the article by Barthold in Raumer's 'Historisches Taschenbuch' (2d series, Vol. III, 1842); Wülcken, 'Urkunden und Schreiber, betreffend den Zug der Armagnaken' (Frankfort 1873); Chevalier, U., 'Répertoire des sources historiques du moyen âge' (Montbéliard 1894); Dognon, Paul, 'Les Armagnacs,' etc., in *Annales du Midi* (1889); Witte, 'Die Armagnaken im Elsass, 1439–1445' (Strassburg 1889).

ARMAMENT, a term used in its broader sense to designate the military and naval equipments or forces of a nation; in its more technical meaning it is used to designate the weapons with which these forces are supplied, such as ammunition and gun mountings, torpedoes, torpedo tubes, etc. See AMMUNITION; ARMY; ARMS AND ARMOR; NAVAL GUNS; WARSHIPS, etc.

ARMAMENT DISTRICT. For the maintenance and improvement of the mobile and seacoast artillery and accessories, armament districts are established in orders from the War Department, and the assignment of armament officers to the charge of these districts is made by the chief of ordnance. These officers keep themselves informed of the condition of the material by inspections and by direct correspondence with the various district and post commanders. The former are authorized to make the necessary repairs to material in their districts, but no alterations can be made without the authority of the chief of ordnance. Where repairs indicate improper handling or neglect of material, the circumstances are reported to the chief of ordnance. When mechanics employed by an armament officer are on duty at a post or in a district, they, in the absence of the armament officer, are under the supervision of the post or district commander. When a part of or an accessory to an article constituting a portion of the armament of a district becomes obsolete and is replaced, the obsolete part or accessory is transferred by the district commander to an arsenal to be designated by the armament officer.

ARMAND, är'mäṅ, **Charles Teffin,** (MARQUIS DE LA ROUARIE), French soldier: b. 1753; d. 1793. He was dismissed from the French army for fighting a duel about an actress. Coming to America in 1777, he was given a colonel's commission in the American army, succeeded Pulaski in command of the "Pulaski Legion," in 1779, soon renamed "Armand's Partisan Corps," and became a brigadier-general in 1783. Returning to France he was active on the Royalist side in the French Revolution. Consult the 'Memoir' by Townshend Ward (in *Pennsylvania Magazine of History and Biography,* Philadelphia 1878).

ARMANDE, an elder sister of Henriette in Molière's 'Les Femmes Savantes.'

ARMANSPERG, är'mans-perg, **Joseph Ludwig, Count von,** Bavarian statesman: b. 1787; d. 1853. He became Bavarian minister of foreign affairs in 1826, and later of the interior and finances. His opposition to the claims of Rome drew upon him the hatred of the Catholic clergy and contributed to bring about his dismissal. He accompanied King Otho to Greece in 1830. He was president of the regency of Greece, 1833–35, and chancellor of state, 1835–37.

ARMATOLES, är'mä-tōlz, bodies of Greek militia inhabiting districts in the mountains of Greece assigned to a *capitani* for protection before Greece became independent of Turkey. To these fastnesses fled the independent part of the Greeks, in order to continue the war under leaders called *capitanis.* A capitani collected generally a troop of from 50 to 200 men, who remained true to him through every variety of fortune, and attacked the enemy everywhere. Thus involved in an endless struggle with their oppressors, these Greeks were apt to degenerate and become little better than bandits. A large number of them were careful to confine their depredations to Mussulmans; but many instances occurred in which Greeks were attacked when the booty expected was considerable. The Turkish pashas, unable to subdue the armatoles, treated with them; and the capitanis received, on condition of remaining quiet, money, stores or other perquisites. They thus became a sort of rural police, having custody of the highways. The Turks disliked their growing power and after 1739 sought to weaken the organization by restricting the privileges and introducing Mohammedan Albanians into the companies, or *armatoliks.* The armatoles aided Ali Pasha

considerably in 1820–22, and greatly aided their countrymen during the Greek war of independence.

ARMATURE, a term applied to the piece of soft iron placed across the poles of permanent or electro-magnets to receive and concentrate the attractive force. In the case of permanent magnets it is also important for preserving their magnetism when not in use, and hence it is sometimes termed the keeper. It produces this effect in virtue of the well-known law of induction, by which the armature, when placed near or across the poles of the magnet, is itself converted into a temporary magnet with reversed poles, and these, reacting upon the permanent magnet, keep its particles in a state of constant magnetic tension, or, in other words, in that constrained position supposed to constitute magnetism. A horseshoe magnet should therefore never be laid aside without its armature; and in the case of straight bar-magnets, two should be placed parallel to each other, with poles reversed, and a keeper or armature across them at both ends. The term armature is also applied to the core and coil of the electro-magnet, which revolves before the poles of the permanent magnet in the magneto-electric machine, and to a part of the telegraph sounder. It is also very generally applied to the part which is revolved between the poles of the field magnets of a dynamo or motor. The iron cores on which the coils are wound afford a magnetic connection between the poles. Consult Cramp, 'Armature Windings' (London 1906); Kinzbrunner, 'Continuous Current Armatures' (New York 1906).

ARMED NEUTRALITY. The term "armed neutrality" has been applied to the collective action of the neutral states which employ their armed strength for the purpose of compelling belligerents to respect their rights. There have been two well known examples of armed neutralities, namely those of 1780 and 1800. Both were formed mainly for the purpose of bringing pressure to bear upon Great Britain to compel her to respect the rights of neutral powers during the war in which she was then engaged and for placing a check upon her exaggerated assertion of belligerent claims. Neutrals complained that in consequence of her naval supremacy she committed unwarranted aggressions upon neutral commerce, in particular that she seized enemy non-contraband property in neutral ships, extended the doctrine of contraband beyond all reason and maintained blockades which were illegal because of their ineffectiveness. Among the parties to the first armed neutrality were Russia, Sweden, Denmark, Spain, France, Holland, Prussia, Austria, Portugal and the two Sicilies.

It adopted a declaration that enemy goods in neutral vessels, contraband of war excepted, were not liable to capture; that a blockade to be legal must be effective, that is to say, vessels of the blockading squadron must be placed sufficiently near the blockaded port to make entrance to it dangerous; and other similar rules in the interest of neutrals were laid down.

The second armed neutrality of 1800 was a similar arrangement for similar purposes. The objects of both were partially realized but it is significant that when the parties became belligerents themselves, as most of them did shortly afterward, they abandoned for the most part the principles which as neutrals they had striven to enforce. See NEUTRALITY.

JAMES W. GARNER.

ARMED SHIP, a term applied to a ship formerly which had been granted a letter of marque by government authority and which entitled it to the privilege of mounting guns and attacking an enemy's commerce, such vessels being more commonly known as privateers. The term now applies more to commercial ships which are utilized by the government in time of war, in part or wholly, and are armed at the government expense. Special significance has been attached to the term during the great European War, on account of the tendency of the commanders of German submarines to sink all vessels without warning, the United States government contending that all unarmed ships should first be warned and the crew and passengers be given time to leave.

ARMED SOLDIER OF DEMOCRACY, a term occasionally applied to Napoleon Bonaparte because of his supposed expression of the ideals following the French Revolution.

ARMENIA, a mountainous region of western Asia with an area of about 140,000 square miles. It is now partitioned among Turkey, Persia and Russia, their boundaries meeting at Little Ararat.

The plateau of which Armenia chiefly consists is a continuation of the Great Tranian plateau. It is bounded on the north by the Black Sea, descends abruptly to the lowlands of Mesopotamia on the south and more gradually on the east and west to the plateaus of Persia and Asia Minor. It has a mean elevation of about 6,000 feet and is mountainous and volcanic. The ridges, of which there are four principal, are generally parallel to each other, running, with sundry deviations, east and west, and between them are broad valleys; that of the Aras, at Mount Ararat, being 2,890 feet and many others 5,000 to 7,000 feet above the sea-level. The mountains are mainly composed of stratified rocks, with slate, limestone, etc., appearing on the sides of the chains. Granite is also met with but is not frequent; and in the north Palæozoic and in the south later sedimentary rocks are superimposed on archaic rocks. Its volcanoes are all quiescent, unless we except Ararat, of which an eruption took place in 1840, accompanied by a disastrous earthquake. A few mountains, as Ararat, 17,000 feet, Alaghez and Bingöl Dagh, rise above the line of perpetual snow but this is not generally the case; and there are no passes but such as can be crossed in a single day. Saltpetre, lead, iron and copper are found in the mountains; and the last two have to some extent been wrought in modern times. Rock salt is plentiful and is exported in considerable quantities to Persia and elsewhere. Mineral waters abound but little or nothing is known of their qualities. Several important rivers take their rise in Armenia, namely the Kur or Cyrus, and its tributary the Aras or Araxes, flowing east to the Caspian Sea; the Churuk Su, or Tchorak and the Halys or Kelkid Irmak, flowing north to the Black Sea; and the Tigris and

Euphrates, which flow into the Persian Gulf. There are also several minor tributary streams. The only considerable lakes are those of Van, in Turkish Armenia, 78 miles in length and about 32 in breadth; Goukcha or Sevan northeast of Erivan, in Russian Armenia, about 40 miles long by 15 broad; and Urumiyah or Urmia, in Persian Armenia, 80 miles long and 24 broad. It is abnormally salty, while Lake Van is heavily charged with soda.

The climate of Armenia is very severe, presenting a marked contrast to that of the warm regions of the Lower Euphrates and to the mildness prevalent on the shores of the Black Sea. Winter in Armenia continues from October to May, spring and harvest a month each, and the change to the summer is very rapid. The heat, especially in the valleys during summer, is great and rain seldom falls. In Erivan, which is a degree of latitude south from Trebizond, the thermometer in winter falls 36° F. lower than it does in the latter; and in summer it rises 24° F. higher. On the plateaus of Erzerum, Gumri, etc., the difference is still greater; indeed, in the town of Erzeroom the snow lies in the streets for eight months of the year. East and southeast winds in summer, west winds in spring and northeast storm winds in winter, are most prevalent. The soil of Armenia is reckoned on the whole productive, though in many places it would be quite barren were it not for the great care taken to irrigate it. Wheat, barley, tobacco, hemp, grapes and cotton are raised; and in some of the valleys apricots, peaches, mulberries and walnuts are grown. From the nature of the country the rearing of stock is carried on to a greater extent than agriculture. The horses are spirited, fleet and fiery. Pines, birches, poplars and beeches flourish but there are no thick forests except in the northern parts of the country. The flora is not so varied as might be expected in such an Alpine country; in several respects it resembles the vegetation of the Alps of Tyrol and Switzerland.

The inhabitants of Turkish Armenia number about 2,470,000. Besides those of the genuine Armenian stock, in consequence of the repeated subjugation of the country, various other races have obtained a footing. Of these the principal are the Turks and the predatory Kurds; on the Tchorak, Georgians; and throughout the whole country, Greeks, Jews and Gypsies. Before the European War the total number of Armenians was estimated at over 2,500,000, of whom about 650,000 were in Turkish Armenia; about 576,000 in the rest of Asiatic Turkey; about 400,000 in European Turkey; about 1,119,000 in Russian Transcaucasia; and 100,000 in Persia. Since the outbreak of the war, however, an appallingly large number have been exterminated in Turkey. The remainder, like the Jews, are scattered over various countries, and being strongly addicted to commerce, play an important part as merchants. Of late years many have emigrated to America and they are also to be found in Hungary, Italy, Africa and India, chiefly in the great marts, Bombay, Madras and Calcutta. Everywhere they are engaged in banking and trading. Their eyes and hair are black, their looks lively, noses aquiline and their complexion somewhat swarthy. The women are remarkable for the delicacy and regularity of their features. Like the Jews, whom in many respects they resemble, their ruling passion appears to be an inordinate love of gain, but they are generally esteemed honest. Their mental capacity is good and those who are educated are distinguished by superior cultivation and refined manners; but the mass of the people inhabiting their native country, in consequence of centuries of neglect, are grossly ignorant and superstitious.

History.—The legendary history of Armenia begins with Haïk, son of Togarmah, the great grandson of Noah, mentioned in Gen. x, 3. He is said to have taken refuge in Armenia from the tyranny of Belus, King of Babylon, who was slain in pursuit of him. The seventh king in descent from Haïk was killed in battle with Semiramis and the country became tributary to Assyria. From Haïk the country derived the name Haikistan, and from Armenak, one of his successors, that of Armenia. Armenia continued subject to Assyria under its own princes till the revolt of the Medes and Babylonians against Sardanapalus, when Barbak, the King of Armenia, joined these powers and recovered his independence. Tigranes I is said to have been the ally of Cyrus against Astyages and to have built the city of Tigranocerta. His successor, Vhakin, the legendary hero of Armenia, was deified after his death. Vahi, the last of the dynasty of Haïk, was killed in fighting against Alexander the Great as the ally or vassal of Darius. The duration of the dynasty was about 1,800 years. Armenia was now incorporated with the kingdom of Syria. It recovered its independence under Ardvates, 317 B.C., during the dissension among the successors of Alexander, but on his death submitted to the Seleucidæ. About 190 B.C. Artaxias and Zariadres, two Armenian nobles, freed themselves from the dominion of Antiochus the Great and established the kingdoms of Armenia Major and Armenia Minor. Armenia Major was reconquered from Artaxias II by Antiochus Epiphanes. About 149 B.C. Mithridates, or Arsaces VI, King of Parthia, whose dominion extended over Media, Persia and Babylonia, placed his brother Wagherschag or Valarsaces on the throne of Armenia and introduced the dynasty of the Arsacidæ into the country. He built cities and organized the defenses of the country. His great grandson, Tigranes II, whose long reign appears to have begun about 96 B.C., conquered Artenes, King of Sophene or Armenia Minor, and united all Armenia under his sway. He was successful in war against the Parthians and made himself master of the whole Syrian monarchy. He is also said to have founded or built Tigranocerta, the origin of which is likewise attributed to his probably mythical predecessor. Being the son-in-law of Mithridates, King of Pontus, while Mithridates was preparing to renew his war with the Romans after the death of Sulla, he invaded Cappadocia at his instigation and carried away much spoil and many prisoners. Mithridates, after his defeat, took refuge with Tigranes, who does not seem to have been disposed to render him active assistance; but Lucullus made a peremptory demand through Appius Clodius

for his surrender, which left Tigranes no alternative but a declaration of war, 69 B.C. Disregarding an invasion of Cilicia, Lucullus at once carried the war into Armenia, defeated the numerous forces of Tigranes and captured Tigranocerta. Antiochus Eusebes was reinstated on the throne of Syria, and other dependents of Tigranes revolted. Tigranes in the meantime, with the assistance of Mithridates, collected another army which was again defeated by Lucullus. Favored by disaffection among the Roman troops, however, Tigranes recovered the greater part of Armenia and defeated Fannius, the lieutenant of Lucullus. Pompey, who arrived in 66 B.C., after overthrowing Mithridates, who had also recovered his dominions, advanced to Armenia, which was at the same time invaded by the Parthians, instigated by the revolted son of Tigranes. The Parthians speedily withdrew and young Tigranes fled to Pompey. At this critical juncture the elder Tigranes hastened to make his submission to the Roman general, who left him in possession of his kingdom, but deprived him of the provinces of Sophene and Gordyene, which he erected into a kingdom for the younger Tigranes. The elder Tigranes continued faithful to the Roman alliance, and Gordyene, which had been seized by the Parthians, was soon after restored to him. Tigranes died about 55 B.C. His son Artavasdes was made prisoner by Antony and carried to Egypt where he was put to death by Cleopatra in 30 B.C. Armenia, lying between the Roman and Parthian empires, became a battlefield where they disputed for mastery, and with difficulty maintained its independence under princes from the family of the Arsacidæ till the time of Trajan, who made it a province. It was given up by Hadrian and again ruled by the Arsacidæ. Chosroes defended it during a long reign against the power of Persia, which had recently re-established its monarchy on the ruins of the Parthian empire; but about 258–59 A.D. Sapor, King of Persia, unable to subdue Chosroes by force of arms, caused him to be assassinated, and his son Tiridates being an infant, took possession of the country. Tiridates was restored by the Romans in 286, the third year of Diocletian. At the beginning of his reign he persecuted the Christians, who were numerous in Armenia, but was himself converted to Christianity, it is said, by Gregory the Illuminator. Armenia was thus the first country which officially embraced Christianity. On the defeat of Galerius by the Persians in 296 Tiridates, who fought valiantly as the ally of the Romans, was compelled to follow the retreat of his protectors; but the succeeding campaign restored him and his dominions were extended in the peace with Persia which followed. By the treaty into which Jovian, the successor of Julius, entered with Sapor II, 363 A.D., the Romans were compelled to abandon the protection of Armenia. It was speedily reduced to a Persian province, but after the death of Sapor its independence was restored in a new treaty of peace made with Theodosius in 384. The country long oppressed by the contentions between the Romans and Persians, soon fell into division through the attraction of these rival powers (387). A Persian king or governor, Chosroes, was set up over the eastern, and a Roman, Arsaces, over the western portion of the country, both being of the royal house of Armenia. On the death of Arsaces the Romans suppressed the form of royalty and annexed their portion of the country to the empire under the military command of a count of the Armenian frontier. This occurred in the reign of Theodosius II. On the death of Artasires or Ardashir, the successor of Chosroes, Bahram V of Persia (about 428) annexed the Persian portion under the name of Persarmenia. The Persians exerted themselves to extirpate Christianity but failed to do so; and on the fall of Sassanidæ (632) the country was united again under the Greek empire. After the Arab invasion in 637 it became the scene of incessant struggles between the declining empire and the rising Mohammedan power and as it was persecuted by the emperors for its adoption of the Monophysite heresy its sympathies were not always with the former. The dynasty of the Pagratids or Bagratidæ was established by the arms and influence of the caliphs. It was a family of Jewish origin and appears to have risen gradually to influence in the country. The date of its elevation to royalty is usually given as 885, but a much earlier date is sometimes assigned. It lasted till 1079, when the country again became dependent on the Greek empire. During this period several other dynasties which it is not necessary specifically to notice reigned simultaneously in different parts of the country. On the fall of the Pagratidæ, Rhupen or Ruben, a relative of the last king, founded a small kingdom in the north of Cilicia, which gradually extended to the Mediterranean and was known as Lesser Armenia. It rendered valuable assistance to the Crusaders, and its later rulers were of the house of Lusignan, styled Kings of Cyprus, Jerusalem and Armenia, the last of whom, Leon VI, was taken prisoner when the country was conquered by the Mamelukes in 1375. Armenia formed part of the empires of Genghis Khan and Tamerlane and a great part of it was conquered by Selim II in 1522. Henceforth it was shared between the Turks and Persians, the former having the greater part of it. In 1828 Russia obtained a considerable portion of Persian Armenia and this was augmented in 1878 by the Turkish possessions of Batum, Ardahan and Kars, ceded by the treaty of Berlin. Russian Armenia includes the governments of Erivan and Elizabethpol, the territory of Kars, etc., with the important towns of Tiflis, Kars and Erivan. Persian Armenia forms part of the province of Azerbaijan. Turkish Armenia, which includes most of Kurdistan, is composed of the vilayets of Erzerum, Mamuret-ul-Aziz, Diarbehr, Bitlis and Van, with an area of 71,990 square miles.

Armenian Question.— The so-called "Armenian Question" began after the Russo-Turkish War of 1877–78. By the treaty of Berlin the Sultan promised much needed reforms for his Armenian subjects to the great Powers, particularly Great Britain and Russia. After 1884, however, Russia's policy toward the Armenians changed, the reforms were not effected and revolutionary movements, in imitation of the Russian Nihilist propaganda,

started among the oppressed Armenians. The Turkish government called upon the Kurds to police the country, sanguinary conflicts ensued, and in 1895–96 brutal and atrocious massacres by the Kurds, aided by Turkish soldiers, occurred at Trebizond, Van, Bitlis and in many other parts of the country and entire Armenian communities were wiped out. England, France and Russia protested, the Sultan promised reform and reparation, a commission of investigation was formed, but the massacres continued, and in August 1896 from 4,000 to 6,000 Armenians perished in the streets of Constantinople at the hands of the mob, in retaliation for the seizure of the Ottoman bank by Armenian insurgents. Revolutionary propaganda and minor massacres continued until the Young Turk Revolution of 1908, at first enthusiastically supported by the Armenians. A year later, however, at Adana and throughout Cilicia and northern Syria another massacre on a large scale occurred and 30,000 Armenians were killed. In April 1915, after the outbreak of the European War, the Turkish government started to put into execution what seemed a systematic plan for the extermination of the Armenian race, and it has been estimated that nearly a million Armenians have perished.

Art.— The only important ruins of the Roman period are at Karni. After the country had become Christian many churches were built, possessing much architectural character. The oldest of these still surviving is probably the Church of Saint Ripsima at Vagashabad (618), but the most interesting is the cathedral at Ani, built about 1010, while of nearly equal importance is the cathedral of Kiutas, on the basilican plan. A church with a striking dome and five naves, belonging to the same century, is found at Mowki and there are many others remarkable for the delicacy of decorative details. The most richly ornamented of these is that at Mtzkhet in Georgia, belonging to the 15th century. The Armenian architects and artists were much given to the employment of decorative inscriptions, as were their Mohammedan neighbors, and in their use of animal and decorative sculpture, especially for wall panels and for broad bands surrounding windows they showed great artistic sense and originality. Carving in wood and ivory was much practised but the Armenians especially excelled in the production of cloisonné enamel and in the employment of geometric ornament applied to buildings as well as to small objects, such as the sacred vessels of the church and toilet articles. Wall-painting was also an Armenian accomplishment and one in which not a little independence of Byzantine influence was exhibited. Illuminated Mss. were brought to great perfection in the 13th century. Fine collections of them are preserved in the Armenian Library in Venice and in the monastery of Etchmiadzin in Russian Caucasus, the national sanctuary of the Armenian church.

Armenian Church.— The Armenians received Christianity as early as the 3d century. During the Monophysitic disputes, being dissatisfied with the decisions of the Council of Chalcedon (451), they separated from the Greek Church in the year 536 and called themselves the Gregorian Church, after Gregory the Illuminator. The Popes have at different times attempted to gain them over to the Roman Catholic faith but have not been able to unite them permanently and generally with the Roman Church. There are, however, at present about 100,000 United Armenians scattered in Russia, Poland, Galicia, Persia and Italy who acknowledge the spiritual supremacy of the Pope; they agree in their doctrines with the Catholics but retain their peculiar ceremonies and discipline. At different times force has been used to make the Gregorian Armenians conform to the religion of Mohammed; but the far greater part are yet Monophysites and in spite of fierce persecutions have remained faithful to their old religion and worship. Their doctrine differs from the orthodox chiefly in their admitting only one nature in Christ and believing the Holy Spirit to issue from the Father alone. In their seven sacraments, which they call mysteries, there are these peculiarities, that in baptism they sprinkle thrice and dip thrice, and this is immediately followed by confirmation; that in the Lord's Supper they mix no water with the wine and use leavened bread, which they distribute dipped in wine; and that they allow extreme unction only to divines immediately after their death. They adore saints and their images, but do not believe in purgatory. In fasting they surpass the Greeks. Their feasts are fewer than those of the Greeks but they celebrate them more devoutly. They worship, in Turkey mostly in the night time; the mass is said in the ancient Armenian, the sermon is preached in the modern. Their hierarchy differs little from that of the Greeks. The *catholicus* or head of the church has his seat at Etchmiadzin, a monastery near Erivan, the capital of the Russian Armenia, on Mount Ararat. The holy oil, which he prepares and sells to the clergy and the frequent pilgrimages of the Armenians to Etchmiadzin, supply him with means for the support of a magnificent style of worship and of establishments for education. He maintains in his residence a seminary for the education of divines. There is here also a printing press. When the office of *catholicus* is vacant two candidates are elected by the people, through their representatives in each diocese, and the Tsar chooses between them. The patriarchs of Constantinople and Jerusalem, the bishops and archbishops are invested by the *Catholicus* and every three years confirmed in their offices or recalled. In Turkey the Patriarch of Constantinople is the official as well as the real ecclesiastical head of the nation and presides over the National Assembly which includes two administrative bodies: the committee for civil affairs and the committee for ecclesiastical affairs. The remainder of the clergy are often ignorant but generally respected and resemble the priests of the orthodox church in rank and duties. The monks follow the rule of Saint Basil. The *vartabets*, who live like monks, cultivate the sciences, take degrees, which may be compared with the usual academical honors and are the vicars of the bishops, form a class of divines peculiar to the Armenian Church. The secular priests must be married once, but are not allowed to take a second wife. Armenian churches have

been established in the United States wherever a considerable body of Armenian refugees have settled.

Language and Literature.— The Armenian language is, according to H. Hubschmann, one of the main divisions of the Indo-Germanic group of languages though formerly considered a dialect of the Iranic branch. The Old Armenian or Haikan language, which is still the literary and ecclesiastical language, is distinguished from the New Armenian, the ordinary spoken language, which contains a large intermixture of Persian and Turkish elements. The most learned Armenian antiquaries do not pretend to trace their literature further back than about 150 years before the Christian era when Marabas Catina wrote a history of Armenia, and earned for himself the title of the Armenian Herodotus. He was followed by some half dozen historians and mythologists, but all these early productions are lost, though they have not been quite valueless, inasmuch as they were the sources whence later Armenian writers compiled work still extant. The authors who lived in the 4th century of the Christian era are the first whose writings have been preserved. Christianity then prevailed in Armenia, and her authors were princes and prelates. The 5th century was the golden age of Haikan literature. This century was fruitful in authors, and was further distinguished by two events important to the progress of learning. The Armenians till then had had no alphabet of their own, indifferently using Greek, Syrias, and Persian characters. Early in the 5th century Mesrop Masdoty invented a Haikan alphabet of 36 letters, still called, in honor of the inventor, Mesropian, and now employed as capitals, since others of more convenient form have supplanted them in common use. About the same time schools were instituted throughout Armenia, and the scholars there trained exerted themselves in producing Haikan versions of the Bible, the earliest of which was completed by 412, and of the masterpieces of Greece and Rome. One of the most distinguished authors who now appeared was Archbishop Moses Chorenensis or Moses of Chorene. Besides innumerable translations, he wrote a history of Armenia, and a treatise on rhetoric — all of which, together with some homilies, have been preserved as well as some hymns still habitually sung in the Armenian Church service. A treatise on geography also ascribed to him dates probably from the 7th century. His 'History of Armenia' was published in London in 1736, with a Latin translation, by the celebrated W. Whiston and his son George. It was published at Venice in 1752, 1827, 1865 and 1881; was translated into French by Levaillant de Florival in 1841, and into German by Lauer (Regensburg 1869). Other celebrated Armenian authors of the golden age are Eznik of Golp; Korune, the biographer of the learned Mesrop; Elisaeus, author of a history of the Vardanants; Lazar of Parpi; Agathangelos, and the historian Faustus of Byzantium, who probably wrote in Greek. In the 6th century Haikan literature first remained stationary, and then began to decline. It revived somewhat in the 12th century but after the 14th declined steadily until the 17th. During this period authors abounded, but in a literary sense their productions were worthless. A few histories, however, national, Tartar, Arab etc., some of them in verse deserve esteem for the information they contain. In the 17th century Armenian schools and colleges arose in the East and in the West, Armenian printing presses were set up in various towns, and Armenian literature began to revive. In the 18th century the revival was complete, very much owing to the zealous and judicious exertions of Petro Mechitar, a Catholic Armenian, who in 1701 founded a religious society at Constantinople for the purpose of elevating the Armenians by diffusing among them a knowledge of their ancient literature and language. Being persecuted by the opposite sect he fled with his adherents to the Morea, then under the Venetians, and established a monastery and academy at Modon. The Morea reverting to the Ottoman sceptre, Mechitar transferred his institution to the small island of San Lazaro at Venice, where it has ever since remained and prospered. Abbot Mechitar, during the remainder of his life (he died in 1749) successfully exerted himself to render his monastic college the chief seat of Armenian erudition and education. The best Armenian press extant is the Mechitarist, from which issues a newspaper that circulates widely in the Levant. Here many of the classical works of England, France, Italy, and Germany have been translated into Armenian. There is also a Mechitarist college in Vienna, and a branch in Munich. Wherever any extensive community of Armenians have settled they have set up a printing press, as in Amsterdam, Leghorn, Moscow, Venice, Astrakhan, Constantinople, Smyrna, Tiflis, Saint Petersburg, Madras, Calcutta, etc., and at several of these places periodicals are published. The founder and greatest master of modern Armenian literature is the novelist Raffi (1837–1888). A splendid dictionary of the Armenian language with Latin and Greek equivalents for each word was published by the Mechitarist press at Venice in 1836. The best Armenian dictionaries for foreigners are the Armenian-French one published at Venice in 1812; the Armenian-Italian of Emmanuel Tchaktchak (Venice 1837); the Armenian-English of Aucher as improved by Bedrossian (Venice 1868–79, both Armenian-English and English-Armenian); and the French-Armenian of Norayr (Constantinople 1884).

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HENRI KLEIN and C. L. STUART.

ARMENIAN ART. See ARMENIA.

ARMENIAN CHURCH. See ARMENIA.

ARMENIAN LANGUAGE AND LITERATURE. See ARMENIA.

ARMENTIERES, är'mäṅ'tyär' (Latin, *Armentaria*), France, town on the Belgian frontier, 10 miles west-northwest of Lille, on the Lys. The town has a communal college and factories for spinning flax, hemp and cotton yarn. There are also manufactories of woolen cloth, table linen, calicoes, lace, thread, beetroot sugar and tobacco; bleachfields, distilleries, soap-works, tanneries and salt-refineries, with a considerable trade in grain, brandy, iron, tobacco, soap, etc. Bricks are made in the neighborhood in large quantities. Armentieres was occupied by the German armies in their offensive against Paris in 1914. In the several offensives during the war it was the scene of much hard fighting. Pop. (1911) 28,625.

ARMFELT, Gustav Mauritz, Swedish courtier and diplomat: b. Finland, 31 March 1757; d. Tsarskoe-Selo, 19 Aug. 1814. His amiability, brilliant social gifts and unwavering loyalty commended him to Gustavus III, who entrusted him with important negotiations. In 1783 he took part in the negotiations with Catherine II, with the Danish government in 1787 and during the Russian war of 1788–90 was one of the most active counselors. He displayed great bravery in the field and concluded the peace of Verela in 1790. By the will of Gustavus III, who was assassinated in 1792, Armfelt was appointed to care for the infant son of Gustavus and made a member of the council of the regent, Charles, Duke of Sudermania. The latter found means to destroy the will and Armfelt was sent as an ambassador to Naples to be out of the regent's way. From Naples he wrote to Catherine II, urging her to help overthrow the regency and induce the states to proclaim Gustavus IV of age. The regent's spies discovered the plot and Armfelt only escaped from the war vessel sent to Naples to seize him, through the aid of Queen Caroline. He fled to Russia, and at home was condemned to confiscation of property and death as a trator. When Gustavus IV reached his majority in 1799 Armfelt was restored to all his honors. He was sent as ambassador to Vienna in 1802, but was obliged to quit this post for attacking the Austrian policy in relation to Napoleon I. In 1805–07 he commanded the Swedish forces in Pomerania and there he displayed remarkable ability. When Gustavus IV was deposed in 1809 Armfelt would not treat with the revolutionary leaders. He was among the most courageous supporters of the Crown Prince Gustavus, and when Bernadotte was placed at the head of the nation Armfelt decided to remove to Finland. In 1811 he was expelled as a conspirator. On retiring to Finland he was held in high esteem by Alexander I. The grand-duchy of Finland was erected into an autonomous state and Armfelt was its first governor-general. He was made a count and appointed chancellor of the University of Abo, and member of the Russian senate. Consult Bain, R. N., 'Gustavus III' (Vol. II, London 1895), and Tegner, Elof, 'Gustaf Mauritz Armfelt' (Stockholm 1887).

ARMIDA, a grand heroic opera by Christoph W. Gluck (1714–87); libretto by Philippe Quinault, a 17th century poet, who had written it for another composer, Lully. It is founded on an episode from Tasso's "Gerusalemme liberata," and was utilized by Gluck nearly 100 years after the libretto had been written. The music he composed to it is sublime in grandeur and is regarded as a classic of the highest type. Armida, the Queen and enchantress, dwells in a magnificent palace in Damascus; the period is the 11th century. The gallant knights crusaders fall under the charm of Armida; but not so Rinaldo, the famous hero in Godfrey de Bouillon's army. Unjustly accused of a misdemeanor, Rinaldo has been expelled from the army and wanders alone in the forest. He has been warned against the wiles of Armida, but he scoffs at the idea of any woman compelling his love. But the sorcery of Armida is at work; languorous music overcomes him and he falls asleep in a green valley. Enraged at his scornful indifference, Armida has decided to kill him, but love conquers hate and the dagger falls from her hand. Though she strives against her tender passion, she succeeds in enthralling him with her display of devotion. Meanwhile de Bouillon has dispatched two knights to recall Rinaldo — a Danish warrior and the knight Ubalt. These two also fall victims to Armida's witchery. The Dane meets a demon who has assumed his bride's face and tenderly calls him, but Ubalt breaks the spell and both reach Armida and Rinaldo. The call of duty and honor awakens Rinaldo from his love dream and he resolves to return with his companions. Armida's passionate entreaties

fail to shake his resolution; he departs, and in despair she curses her love and him who provoked it, and turns her palace and gardens into a wilderness. In the sequel Armida becomes a Christian. Aside from the ones already named, the story has been made the subject of operas by Cherubini (1784), Zingarelli (1786), and Rossini (1816). Consult Beloni, 'Gli epigoni della Gerusalemme liberata' (Padova 1893).

ARMIDALE, Australia, town in Sandon County, New South Wales, 313 miles north of Sydney. It lies at an elevation of 3,313 feet, in a picturesque mountainous district, for the most part pastoral and agricultural, though it contains some alluvial gold diggings. Antimony is found in large quantities near the town. It has two fine cathedrals, its schools include the New England Girls' School, Saint Patrick's College, the high school, the Ursuline Convent and state schools. Armidale became a municipality in 1863. Pop. 4,250.

ARMINIANISM, a term applied to a certain phase of Protestant theology. In the Netherlands early in the 17th century there was a revolt against the doctrine of unconditional election as taught by the rigid Calvinists. The most important person, though not the first one, in this revolt was Jacob Arminius (q.v.) A controversy was carried on between him and Gomarus over the question of predestination, and, after the death of Arminius, with increased vigor by their followers. In 1610 the Arminians set forth their views in a 'Remonstrance' covering the points in controversy which in substance was as follows:

(1) God decreed to save through Christ those who believe in his Son and who persevere in faith and obedience through life, but he leaves in sin those who are not believers. (2) Christ died for all, but no one except the believer has remission of sins. (3) Man can neither do nor think anything truly good until he is born again through the Holy Spirit. (4) All good in the regenerate man is brought about by the grace of God, but this grace is not irresistible. (5) Those who are truly converted have power given them through the Holy Spirit and the help of Christ, so that if they desire his aid and are not inactive, no power can take them away from Christ.

In 1618 the Synod of Dort met and condemned the five articles, and many of the remonstrant ministers were deposed, but in 1630 they were granted religious liberty. They have continued to the present as one of the smaller religious sects of Holland with a presbyterial organization and a theological seminary at Amsterdam. The present importance of Arminianism is due to the fact that the founders of Methodism (q.v.) incorporated into their system the teachings of Arminius and his immediate followers. This is the belief of the Methodist Church to-day, as well as that of many individuals belonging to churches nominally Calvinistic. Consult Annan, W., 'The Difficulties of Arminian Methodism' (Philadelphia 1860); Blok, 'History of the People of the Netherlands' (Part III, trans. Putnam, New York 1900); Gill, J., 'The Cause of God and Truth: Being an Examination of the Principal Passages of Scripture made use of by the Arminians in Favour of Their Scheme' (4 vols., London 1735–38); 'The Works of Arminius' (trans. 2 vols., Buffalo 1853).

ARMINIUS, the German national hero celebrated by his fellow-countrymen as their deliverer from the Roman yoke: b. 17 B.C.; d. 21 A.D. He was the son of Segimer, a prince of the Cherusci, a tribe inhabiting parts of what is to-day Brunswick and Hanover. His early life was spent in the Roman army where he served with distinction and attained the rank of *eques*. This period was one of great peril for Germany. The Romans had advanced far into the territory of the Teutonic tribes and had erected a series of strong fortresses in order to keep the more turbulent districts in subjection. From 9 B.C. to about 4 A.D. Drusus and Tiberius had campaigned against the Germans; Tiberius proceeded with great circumspection, however, and induced the Germans to live on good terms with the Romans, to adopt Roman habits and mode of living, etc. Arminius, during his years of service with the Roman legions had acquired a knowledge of Latin and also gained an insight into the art of war as practised by the Romans. Returning home in 7 A.D. he found his people secretly chafing under the Roman governor, Quintilius Varus, and resolved to deliver his countrymen from Roman rule.

With this object he secretly organized all the tribes as far as the Elbe, induced Varus to scatter his forces, and in 9 A.D. decoyed Varus with three legions into the fastnesses of the Teutoburg Forest, probably between the modern towns of Detmold and Wiederbruck and near the headwaters of the Ems and the Weser. Arminius fell upon the legions unexpectedly and virtually annihilated them. The news of the disaster caused consternation in Rome and gave rise to the Emperor's despairing utterance: "Varus, restore to me my legions." The Germans did not follow up their victory, however, and both sides maintained peace until 15 A.D., when Germanicus Cæsar led the Romans against Arminius and reduced the latter to great straits, capturing his wife, Thusnelda. In 17 A.D. he was recalled by Tiberius and the results of his two years' campaign against Arminius were lost. After this time no Roman army ever penetrated to the heart of Germany. Arminius' later years were troubled with the internal feuds which broke out among the several tribes, his chief opponent being Marbod, prince of the Marcomanni. By aiming to found a powerful kingdom Arminius drew upon himself the hatred of his countrymen and he was assassinated in 21 A.D. Of him Tacitus says ('Annalia'): "Arminius fought with the vicissitudes of fortune, and fell at last by the treachery of his own relatives; a man of warlike genius, and beyond all question the liberator of Germany." In 1875 a great monument to Arminius was completed. It was by Bandel and was erected on the Grotenburg Mountain, near Detmold. The exploits of Arminius have furnished material for the dramas of Klopstock and others. Consult Dünzelmann, E., 'Der Schauplatz der Varusschlacht' (1889); Fischer, F. W., 'Armin und die Römer' (1893); Kemmer, O., 'Arminius' (1893); Meyer, E., 'Untersuchungen über die Schlacht im Teutoburger Walde' (1893); Uhl, W., 'Das Porträt des

Arminius' (1898); Wilms, A., 'Die Schlacht im Teutoburger Walde' (1899).

ARMINIUS, Jacobus, or JACOB HARMENSEN, the founder of Arminianism (q.v.): b. Oudewater, Holland, 10 Oct. 1560; d. Leyden, 19 Oct. 1609. He early showed marked promise as a scholar, and entered the University of Leyden at the age of 15. His ability was so apparent that certain officials of Amsterdam undertook the expense of his education for the service of the Church. This enabled him to study at Geneva, where Beza was at the height of his influence and by whom Arminius was greatly influenced. He also studied at Basel and Padua and visited Rome, returning to Holland he was ordained in 1588 and became pastor of the Reformed Church at Amsterdam. At that time he was a rigid Calvinist, but milder views of predestination than those which he had learned from Beza having made their way into Holland, Arminius was called upon for a defense of Calvinism. He made a more careful examination of the disputed points and as a result modified his own views, though still holding to predestination. In spite of the opposition which arose because of his changed opinions he was offered and accepted a professorship in the University of Leyden in 1603. A controversy soon broke out between him and his colleague, Gomarus, a zealous and extreme Calvinist. Two parties were formed in and beyond the university, and the controversy was kept up till his death in 1609. See ARMINIANISM. Consult 'J. Arminni Opera Theologica' (Leyden 1629), 'The Works of Arminius' (English translation, Buffalo 1853); and Nichols, 'Life of Jacobus Arminius' (London 1843).

ARMISTICE, a suspension of hostilities between two belligerent powers or two armies by mutual agreement. It may either be for a definite period or until its termination is proclaimed. An armistice throughout the whole theatre of war can be concluded only by the belligerent governments, and does not take full effect until it has been ratified. A partial armistice may, however, be concluded by the commanders of individual armies or army corps, and such an armistice requires no ratification, although it may be disapproved and abolished by the government. An armistice is often concluded for only a few hours to bury the slain, remove the wounded, and exchange prisoners, and also sometimes to allow of a parley between the opposing generals. A breach of an armistice is regarded as a violation of the law of nations. Sometimes a regular armistice is preceded by an actual suspension of hostilities. If the conditions on which an armistice was agreed upon, as that while it lasted all preparations for attack or defense should cease, are violated by either side, the enemy is entitled to resume hostilities at once. A general armistice is usually the preliminary of a peace, and can only be proclaimed by the commanders-in-chief or their home governments.

ARMITAGE, Edward, English historical and mural painter: b. London, 20 May 1817; d. 1896. He studied in Paris, where, 1842, he exhibited his first independent work. In the following year his 'Landing of Cæsar' gained a prize of $1,500 in London; and in 1845 and 1847 he carried off prizes of $1,000 and $2,500. He was made a fellow of the Royal Academy in 1872, and in 1875 was appointed lecturer on painting there. His mural paintings include a series of noble figures of Christ and the 12 apostles, executed for Saint John's Roman Catholic Church in London. His 'Lectures on Paintings,' to the students of the Royal Academy, were published 1883 and another volume, 'Pictures and Drawings' was issued 1898.

ARMITAGE, Thomas, American clergyman: b. Pontefract, England, 2 Aug. 1819; d. Yonkers, N. Y., 20 Jan. 1896. He prepared himself for the ministry and preached his first sermon when 16 years old. Coming to New York city in 1838, he was actively engaged in the ministry of the Methodist Church until 1848, when he became a Baptist, and was pastor of the Norfolk Street Church (later the Fifth Avenue Baptist Church). In 1890 he was made pastor emeritus, given a residence in Yonkers. He was one of the founders of the American Bible Union. He advocated the revision of the Bible, especially in regard to the correct interpretation of the words therein relating to baptism. He published 'Jesus: His Self-Introspection' (1878); 'Lectures on Preaching' (1880) 'History of the Baptists' (1886).

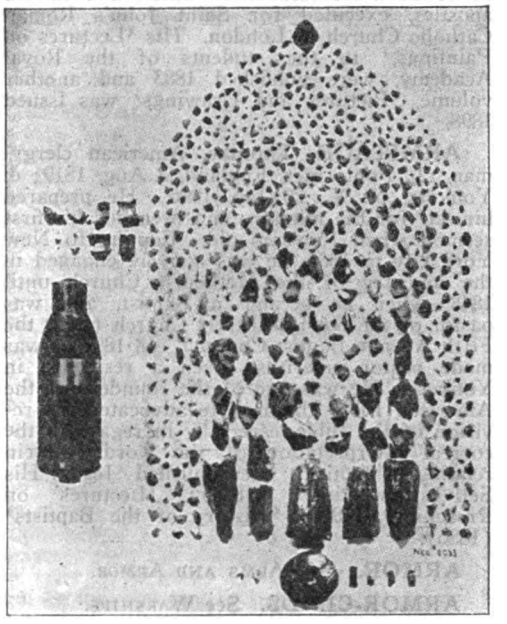
ARMOR. See ARMS AND ARMOR.

ARMOR-CLADS. See WARSHIPS.

ARMOR-PIERCING PROJECTILES. Projectiles intended for practice at objects composed of wood, masonry, or earth are made of cast-iron; but since the introduction of iron for the defense of ships and for fortifications, a material possessing greater hardness than ordinary cast-iron is required to overcome the resistance opposed by thick wrought-iron plates. Both elongated and spherical projectiles for use against armor should be of the hardest and toughest material possible. The power of a projectile to stand up to its work and deliver its full blow on the target depends on the *shape* as much as on the *quality* of the metal of which it is composed.

The flat-ended form of *elongated* projectiles possesses a peculiar advantage as regards the projectile, and another as concerns the plate. As to the projectiles, in direct impact the whole of the resistance of the target acts in lines parallel to the projectile's axis, which direction is the most favorable to the projectile retaining its mass and delivering its full blow on the target; and, again, if the target is to be punched by actual shearing, the flat head is the form best adapted to effect it. The flat head would probably be best in the case of direct firing against plates composed of hard iron, for it is easy to conceive of a hard material offering very great resistance to the forcing open of a pointed head, which might be punched by the clean shearing of a flat-headed projectile. The power given by rotation of keeping the same portion of a projectile presented to the front is of peculiar value in punching armor plates; it enables the head of the projectile to be made of any desired form, while the power of reducing the calibre of projectile in proportion to its weight, which is perhaps the principal advantage obtained by rifling, is also

most important here, the depth of penetration being in inverse proportion to the circumference. In shells, however, this stability of the axis of rotation tells more fully, for it enables



SIX-INCH RIBBED CAVITY ARMOR-PIERCING SHELL.

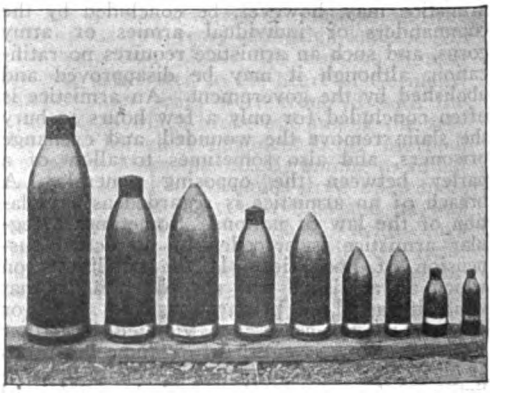
Projectile was loaded with 2 pounds of black charcoal powder and fused with magazine fuse. Fired at 6-inch Krupp hard-faced armor plate. Shell burst about 8 feet to rear of plate after penetrating the same. Weight of largest fragment recovered 10¼ pounds. Average weight of fragments 2 $\frac{5}{16}$ ounces. Total number of pieces recovered, 650.

every part of the projectile to be made of such proportions as will give the maximum power at the moment of impact. The walls of an elongated shell being chiefly subjected to a longitudinal strain, an interior hollow may be made without entailing the great weakness existing in spherical shells as compared with solid shot. Hence it follows that while smooth-bore shells have seldom or never been fired at armor, rifled shells have proved very successful.

There are two causes which contribute to give shells peculiar power against iron plates. The first is that it is not necessary to weaken the head of a shell by making a fusehole in it, because no fuse is required, the heat generated on the impact of a projectile against the armor being sufficient to fire the bursting-charge. To such an extent is light as well as heat generated, that on firing at a target after dark a pale flash is seen to follow the impact. The second cause that operates to favor the action of shells is the fact that when the shell has penetrated to a depth of even a few inches before rupture occurs, the sides are supported by the armor around them, and the explosion, being confined at the sides, acts to the front with greatly increased force.

In a conical head the normal pressures throughout form a zone of compression acting as a wedge toward the body of the projectile, whose angle is the supplement of that of the cone of the head. This is better than that formed in the spherical head, because the angle is less acute, and because the apex of the wedge, instead of being a fixed point throughout (the centre of the sphere) moves along the axis of the projectile as it enters deeper and deeper into the target. In the ogival head it will easily be seen how much superior is the action. In this the wedge is at the commencement slightly acute, but then the resistance acts on a small surface and is comparatively small, and the angle increases, till, at the junction of head and body, it becomes 180°, or a straight line, so that we then have the body of the projectile in much the same condition as the flat-headed bolt driving before it an ogival wedge, which opens the armor by wedging rather than by clipping or punching. As the softer and more plastic natures of plate-iron have been found to hold their bolts the best, and stand the longest, and so have been universally adopted, the ogival has become obviously the correct form of head.

The effect of hardening projectiles is probably much greater than is generally supposed, that is, the amount of work gained is much greater than the increase of strength of the projectile. It is well known that a very small force may under certain circumstances determine the performance or non-performance of a very large amount of work. In like manner a very slight addition to the rigidity of a projectile, by hardening or otherwise, may determine whether a very large amount of work shall be wasted upon the projectile or expended upon the plate. Another means of increasing the work done upon the armor plate in comparison with that done upon the projectile is by increasing the velocity of the latter. That is, a projectile moving at a low velocity may be smashed up or flattened against the plate, while the same projectile fired at a higher velocity may go through the same plate almost uninjured. On this principle a lead shot may be fired through an iron plate, or a tallow candle through a pine board.



ARMOR-PIERCING PROJECTILES CAPPED AND UNCAPPED.

The projectiles shown are a 3-inch capped, a 4-inch capped, a 5-inch and a 6-inch uncapped, 8-inch uncapped and capped, 10-inch uncapped and capped and 12-inch capped.

Numerous trials have shown a superiority of steel projectiles over those made of chilled cast-iron; and although the former are somewhat more expensive than the latter, it would

be misplaced economy to leave any means unavailed of to increase the penetrating power of projectiles. The quality of chilled projectiles, from the nature of their manufacture, is necessarily unreliable; whereas this is not the case with hammered cast-steel, or at least not to the same extent by far, even when large masses are produced, and the difficulty of manufacture increases with the calibre. The most essential difference in the behavior of steel and chilled projectiles on striking the target consists in the reaction on the projectile showing itself in the latter by breaking up, while the former are only set up. As the breaking up of the chilled shells may take place before the bursting-charge comes into operation, whereby the rending effect is considerably prejudiced, this material appears far less adapted for shells than steel. The superiority of steel in this respect is still further increased by the fact that the steel shell can have thinner walls, consequently a larger chamber, and can thus hold a larger bursting-charge than the chilled metal. SEE ARMOR PLATE; PROJECTILES.

ARMOR PLATE. The idea of protecting ships of war and the fronts of fortifications by means of armor plate dates from about the middle of the 19th century. In 1842 experiments were conducted with iron plates made by riveting together plates three-eighths of an inch in thickness to a total thickness of six inches. Those plates did not successfully resist 8-inch guns or heavy 32-pounders at 400 yards; so some modifications were introduced and further experiments made in 1850. In 1853 the French constructed floating batteries which carried four inches of iron armor.

While the European ships were, for the most part, modifications of existing types, the American ships were constructed from new designs, or railway iron and the like was attached to existing vessels. The old *Monitor* and *Merrimac* are the first examples; but with the improvements in gun manufacture, it became apparent that the wrought iron plates as first used could not withstand heavy gun fire. As a result a compound armor plate was developed in England and an all steel plate in France. In 1889 nickel was introduced in steel and a plate of great toughness and resistance was produced. This type of armor proved superior to the old and from then onward the march of progress has increased. In 1890 the Harvey process was advanced and met with great success, followed in 1895 by the Krupp process. These two processes are essentially the same in principle and represent the highest development of the compound type of armor.

Formerly this kind of armor was manufactured by taking a wrought iron plate as a backing and casting upon its face a plate of steel, the former being so heated as to produce as perfect a union as possible. This operation was based on the theory that a plate to resist the powerful energy of a projectile must have a hard face to resist penetration and a tough back to prevent shattering on impact. Difficulty, however, was experienced with the flaking of the steel face, so that the homogeneous nickel-steel plate really superseded this type.

Harvey Process.— Compound armor held the record against shell until the invention of Harveyized plates, introduced in the United States in 1891. A solid steel plate was cemented on the face and then water-hardened, a glass-hard face with a tough backing being thus provided. This invention at once raised the resisting power of armor by at least 50 per cent. When Harvey adopted the method of hardening the surface of plates with a powdered cementing material, Messrs. Schneider invented a process of cementing by means of hydro-carbon gas, followed by water hardening, and this superseded the Harveyizing system. The Harvey plate was faulty in respect of the back not being sufficiently tough to resist the racking effects of the projectiles. The addition of chromium to the nickel-steel and differential treatment in hardening (variation in degree of hardness imparted to front and back), provided the necessary toughness. Nickel-chrome steel is carbonized and hardened on the outer face, gas being used for carbonizing and a water spray for hardening.

Krupp Process.—The manufacture of Krupp armor plate consists of a series of distinct operations requiring great care and attention and covers a period of from four to nine months, depending on the thickness of the plate. The composition of the plate having been determined upon, the necessary elements are melted together in an open hearth furnace. When ready for tapping, the ingot mould having been prepared, the metal is run into a large ladle, from which it is poured into the mould through a gate on the outside, which connects with the interior of the mould at the bottom. The ingot is bottom poured so as to get a more perfect ingot and the large projection on the upper end the sink-head, is an aid in handling. The mould is made up of cast iron sections bolted together to facilitate the stripping of the ingot. After the ingot has cooled it is stripped, that is, it is removed from the mould. Usually 24 hours suffice for the ingot to solidify and cool sufficiently to permit its being stripped, and then the ingot is sent to the heating furnaces preparatory to forging. The ingot after being heated for about 24 hours is taken out of the furnace and receives its first forging. This operation is one of the most wonderful sights in a steel plant: to see a red hot mass of metal, weighing in the neighborhood of 80 tons, being handled entirely by mechanical means with the ease that one would handle a pencil. The ingot is placed on a die under a 14,500-ton hydraulic press and there forged to within a few inches of its finished thickness. At each working of the press the metal is decreased about three inches in thickness, the ingot being moved along until its whole length has been forged. Of course, the length and breadth are increased, the metal under such great pressure flowing evenly in all directions, and this operation is repeated until the required dimensions are obtained.

Schneider Process.— Armored plates are cemented on the surface in furnaces designed for that special purpose. At the Creusot works hydro-carbon gas is used, introduced through pipes. At a dark red heat the hydro-carbons separate, and the liberated carbon penetrates the surface of the steel. The furnaces are fitted with movable hearths on wheels. The plates, having been already molded to their curves by templet, are placed one above another, with spaces between them, into which the gas is introduced. Each space is enclosed

by a cast-steel frame inserted between adjacent plates and rendered gas-tight with an asbestos strand. The sides of the frame are drilled to receive the rows of gas pipes. The pipes, which are water-cooled, contain passages for the gas inlet, the water outlet and the gas escape. The furnace is fired from each side, with blast. The deposition of the carbon goes on until, by a certain appearance of the flame given by the ignition of the escaping gas, the progress of the cementing operation is estimated when the admission of the gas is stopped for a while to permit of equal saturation of the opposed faces. It is then turned on again for a time and these stages are repeated until the cementation is equalized and completed. The temperature of the furnaces is regulated in such a way as to effect the maximum of cementation without risk of melting the surfaces of the plates. The plates cool down in the furnaces to be reheated and hardened subsequently. They are reheated in the vertical position in furnaces and for the water-hardening they are suspended vertically in tanks, through which jets of water are sprinkled on the surfaces of the plates. The rates of cooling can be varied by altering the distances between the plates and walls.

Cementation Process.— It has been the practice of some manufacturers of armor plate to use a series of rolls instead of a press, but it has been proved that the forging of a plate under a hydraulic press effects a more uniform working of the metal and produces a finished plate far superior to one which has been rolled. This statement is borne out by the fact that many of the plants which had installed a costly set of rolls have had the same removed and replaced by powerful hydraulic presses. After forging, the sink-head is cut off and the plate allowed to cool a little in air before annealing. From the annealing furnace the plate is taken to be scaled by pneumatic hammers preparatory to carbonizing. This process consists essentially of heating the plate in the presence of dry carbon or in a gas-carbonizing furnace.

Dry-Carbon Process.— In this process a special dry-carbon furnace is employed; coal is used in the furnace as fuel and the flame passes over the plates, down in front and back under again to the smoke-stack. Usually several plates are carbonized at the same time, the plates being arranged in pairs. The faces to be carbonized are placed together, separated only by a layer of finely powdered wood and animal charcoal. The edges are well sealed and the plates are placed in the furnace through the top and lowered on a bed of sand; the whole is then well covered with sand and if more than one pair are carbonized at the same time they are treated in like manner and placed on top of the first. When all are well protected from contact with the flame the furnace top is closed and the furnace brought up to heat. The heat is maintained at a uniform temperature for a considerable length of time, this time depending on the amount of carbon to be absorbed by the plates and then the furnace allowed to cool. Almost a month is employed in this process from the time the plate is charged until it is taken from the furnace.

Gas-Carbonizing Process.— In the employment of this process the plate, with the face to be carbonized exposed, is placed on a bed of sand in a furnace which is heated by some highly carbonized gas. The flues for the flame entry are built on each side of the furnace and so arranged that they can be used alternately, while a deflector causes the flame to first strike the top of the furnace and then pass downward. After the furnace has been raised to heat, coal gas or one rich in hydrocarbons, is passed along the surface of the plate and the intense heat causes this to be broken up, depositing carbon on the face of the plate. The plate is left in the furnace until the required degree of carbonization is attained. The plate is again scaled and reheated for its second or final forging to bring it to gauge. This forging also serves to smooth up any roughness on the surface. After forging it is again annealed and from the annealing furnace goes to the machine shop, for such machining as can be done preparatory to bending. On return from the machine shop the plate is heated preparatory to bending and this operation requires the greatest skill and experience in order to prevent cracking to a degree which would result in the condemnation of the plate. An allowance, too, must be made for any slight distortion which may occur in the next operation, that of tempering and water hardening. The plate is heated to the required temperature and then subjected to a cold water spray. The bath is of a special design and is arranged to give a pressure of about 15 pounds per square inch.

Manufacture.— The process of manufacture in every detail is of scientific nicety. The melted steel is drawn off into ladles, transported by electric cranes capable of lifting 120 tons and poured into massive ingot moulds, some of which weigh 60 tons without the steel. Some of the ingots weigh 50 tons and are 36 inches thick. They are reheated and rolled out in an immense mill. One of these mills at Messrs. Vickers' works has rolls 36 inches in diameter and 12 feet in length. An ingot 36 inches thick can be rolled down to six inches within half an hour. The thickness after rolling is equal, but the edges are rough and irregular. At this stage the first portion of the cementing process is performed. The plates are laid one on top of another in specially constructed furnaces. Powdered charcoal is sprinkled between the opposed surfaces and the plates remain in the furnaces from 10 to 12 days, the temperature being regulated by pyrometers. During that period the charcoal is absorbed by the plates, increasing the quantity of carbon at and near the surfaces. This does not harden the surface of the plate, but it prepares it for the subsequent hardening which is done at a later stage, after the bending in the case of those plates which have to be curved, and after the planing off of the rough edges in the case of all plates. Both operations involve the use of much massive machinery and careful handling.

Bending and Planing.— The bending is done in hydraulic presses. Messrs. Vickers have two of 8,000 tons power, which will bend plates up to 21 feet long and 11 feet wide. The pressure exerted is three tons to each square inch of the rams. Each weighs 600 tons. The bending of the thickest plates under the powerful persuasion of these presses is easily and quickly accomplished. In the next stage the surfaces are planed on machines which will

carry a plate weighing 30 tons on a moving table, weighing as much, and will reciprocate it under the cutting tools, which cut in both directions. The plate moves at a rate of about 11 feet a minute. In other types of machines the plate is fixed in a pit below and the cutting tools are traversed over it. It is necessary to plane the surfaces of the plates smoothly, for, although they have been rolled and are smooth, the thicknesses are not so uniform as they should be to enable them to be fitted perfectly in their places. Afterward the very rough and irregular edges are planed in machines of a totally different design. Many plates must have their edges beveled and provision is made for dealing with these by means of hinged tool holders. When a large quantity of metal has to be removed the edges are cut or parted with circular saws.

Hardening.— The hardening process comprises two stages — the moderate hardening of the plate right through, which might be more correctly termed tempering, and the intense hardening of the outer face. The first is done with oil, the second with water. In the first stage the plate is reheated in a furnace to an exact temperature and dropped suddenly into a bath of cottonseed oil, large enough to temper the entire plate without becoming itself sensibly overheated. The result is that the plate is hardened or toughened throughout without being rendered brittle. It is both stronger and tougher than it was before immersion, but it would not resist a modern soft-nosed shell. Afterward the surface, which has been saturated with carbon to a depth of from two and a half to three inches, is rendered of excessive hardness by a chilling process. A series of jets of cold water are directed under pressure against the highly carbonized surface, the plate having been heated first. This is continued during two or three hours, by which time the surface to a depth as far as the carbon has penetrated has become of glasslike hardness.

The finished plate is made ready for the inspector who goes carefully over the whole carbonized face, testing every square foot for hardness. The punch must be dulled and the surface of the plate show practically no mark. If this test is satisfactory the *coupon,* which has been previously cut in the machine shop, is broken off to show the structure of the plate by its fracture. Then follows the drill test to show the depth of chill and if the plate passes this test, bars are taken to show its physical characteristics, that is, tensile strength, elastic limit and extension.

Final Test.— After the above tests are completed the ballistic plate is picked — that is, a plate to be fired at and which represents a group of plates. The armor for a battleship is divided into groups of from 400 to 600 tons, as determined by the department. This test is the most important and on its acceptance or rejection hangs the fate of the whole group of armor; as a result the inspector usually picks that plate of a group, which in his opinion is the least likely to pass. Of course, he has a record of all the plates, and going over these most carefully, he chooses the one which for some slight reason or other is not as perfect as the others, assuming that if the plate in question can pass the severe test required of it, the other plates of the group most assuredly can.

The plate having been decided on, it is sent to the proving ground for test. Here it is attached to a structure, braced from the rear and bolted in the same manner as armor on shipboard. When in readiness three shots are fired at it, the actual thickness of the plate determining the gun to be used and the initial velocity. Approximately a gun of the same calibre in inches as the armor in thickness is used and no projectile or fragment thereof shall get entirely through the plate, nor shall any through crack develop to an edge of the plate or to another impact. The plate having successfully passed test, the group is accepted and the remaining plates are finished machined; a replacing plate is substituted for the ballistic one.

EDWARD S. FARROW,
Consulting Civil and Military Engineer.

ARMORED TRACTORS. As the result of experiments conducted in November 1915, at Fort Sill, under the direction of the Field Artillery Board, with caterpillar tractors as motive power for field artillery, and other experiments conducted both at Fort Sill and the Rock Island Arsenal with motor trucks as transports for the same arm of the service, the United States Army has its newest Field Artillery regiment moved by motor power completely. Thus it would appear that the United States was in the lead in establishing practical applications to military use of American commercial engines; and that when the editor of the *Field Artillery Journal* wrote the caption beneath a photograph of a tractor "Artillery Horse of the Future" he was nearer to the truth than such glimpses into the future usually are.

The American built caterpillar tractors, heavily armored, made their appearance from behind the British lines in the battle of the Somme and were revealed as armored motor cars capable of advancing over the rough terrain resulting from the terrific bombardment by high-powered explosive shells. The car or tractor resembles an enormous armadillo. The crew is protected by varying numbers of armored plates, any one of which is impervious to machine gun or rifle fire as well as shrapnel bullets. It is asserted that only a direct hit from a gun of large caliber could put one of these monsters out of action. The car completes the work of the artillery bombardment on the enemy trenches before the infantry advances. Its chief work on the Somme front was to locate the German machine gunners and blow them out of their positions so that they could not mow down the advancing infantry. This done, the infantry could occupy the abandoned enemy positions with comparative ease.

The completed car, as employed by the British, is made simply by enlarging the platform on the tractor so that it extends over most of the machinery and furnishes room for machine guns and their crews and by covering the whole with a tortoise shell of steel armor.

The machine has a fore wheel which is used only for guiding purposes. No weight rests on this wheel and it could be removed altogether without causing the frame of the tractor to dip more than a few inches. The weight is

carried on the two caterpillars. These consist of two belts with corrugated surfaces, on the inside of each of which are two lines of steel rails, jointed in short sections and operated by sprocket wheels. As the endless belt turns with the progression of the machine the forward sprocket wheel lays down the track and the rear one picks it up again.

Each of the caterpillars is under independent control and by starting one while the other is motionless the entire machine can be turned in its own length — a characteristic which would account for some of the strange manœuvres which led observers to describe the «tanks» as wallowing about, «eating houses and pawing the debris under their bellies» and so on.

The pressure on the ground under the caterpillar — the string of steel plates seven feet long and two feet wide on which the entire weight of the machine is supported — is less than that caused by the foot of a horse or even of a man. And owing to the construction and location of the engines, the centre of gravity of the whole machine is near the back of the caterpillar and not more than 18 inches off the ground. For this reason the machine can roll along without danger of tipping over on an almost incredible slope and it can run considerably more than half its length forward over a chasm without any support at all.

When it moves across a trench the front wheel, on which normally no weight rests, crosses first. The forward end of the caterpillar would then move forward over the open part of the trench and the machine be supported by the rear of the caterpillar, where most of the weight was concentrated, on one side with the guide wheel forward to act as a steadier in front. Then by the time the rear part of the caterpillar had reached the edge of the trench the forward part would already be across and there would be very little displacement of the machine. In this way the machine could cross a trench almost as wide as the ground length of the caterpillar.

ARMORER, a term formerly applied to a maker of arms and armor, a very important handicraftsman in the Middle Ages and down to the end of the 16th century and even later. (See ARMS AND ARMOR). At the present day the term denotes persons employed to keep the arms of the soldiers in repair, or the custodian of an armory. On board a man-of-war the armorer is a petty officer appointed to keep the small arms in complete condition for service.

ARMORICA, the country of the Armorici. The name was formed from two Celtic words signifying «upon the sea,» and was apparently applied in ancient times to the whole northern and western coast of Gaul. It was afterward confined to the province of Brittany.

ARMORY, a building, or military station appropriated to the storage of arms, or the use of troops. In the United States the term is generally applied to the headquarters of the local militia, and signifies almost the equivalent of a club house, to which is added a drill shed, for military manœuvres. Many of these are fine examples of military architecture and are equipped with every modern convenience. In Europe the term is often applied to a museum of military antiquities, but is used more generally of the part of an arsenal, barracks, etc., set apart for the armorer and his assistants or where arms and equipment are stored.

ARMOUR, Herman Ossian, American merchant: b. Stockbridge, N. Y., 1837; d. 1901. After several years spent in the grain commission business in Chicago he became in 1865 the New York representative of the Milwaukee firm of Armour, Plankinton & Co., which retained the firm name of H. O. Armour & Co. until 1870. The name was then altered to Armour & Co., which is now the most important provision firm in the world.

ARMOUR, John Douglas, Canadian judge: b. 1830; d. 1903. Educated at Upper Canada College and Toronto University, he was called to the bar in 1853. Appointed a judge of Queen's Bench of Ontario, 1877; was chief justice 1887–90; president of the Court of Appeal 1890–1902; and judge of the Supreme Court 1902–03. He was one of the Canadian representatives on the Alaska Boundary Commission in 1903.

ARMOUR, J. Ogden, American capitalist and packer: b. in Milwaukee, Wis., 11 Nov. 1863, the son of Philip Danforth Armour and Malvina Belle Armour. His mother was a daughter of Jonathan Ogden, a prominent merchant of Cincinnati, and his father, Philip Danforth Armour, was a pioneer in the meat packing industry in America and also widely known for his philanthropy. He endowed the Armour Institute of Technology and the Armour Mission in Chicago, giving them a total of over $2,500,000. J. Ogden Armour was educated at the Harvard School, Chicago, and at Yale University. He did not complete the course at the latter institution, but yielded to the request of his father that he should return to Chicago and relieve him of some of his business cares. Consequently he entered the business house of Armour & Co. in 1883. Beginning as a subordinate, he soon became a partner and later, upon the incorporation of the firm in 1900, was made a director and vice-president. Upon the death of his father in 1901 he became president of Armour & Co. Under his direction the steady and vigorous growth of the firm and its subsidiaries has been maintained. He finds his greatest satisfaction in having successfully carried on, extended and developed the industrial activities and the philanthropic enterprises bequeathed him by his father. Mr. Armour married Lolita, daughter of Martin J. Sheldon, retired capitalist of Suffield, Conn. Mr. Armour is a director in various corporations, including the Chicago, Milwaukee and Saint Paul Railway Co., the National City Bank of New York, the Fort Worth Stock Yards Co., the Stock Yards National Bank, South Omaha, the Continental and Commercial National Bank, the Northwestern National Insurance Co., the Continental and Commercial Trust and Savings Bank, etc. He is also a member of the Illinois State Council of Defense and has published 'The Packers and the People' (1906).

ARMOUR, Philip Danforth, American merchant and philanthropist: b. Stockbridge, N. Y., 16 May 1832; d. 6 Jan. 1901. He was a miner in California in 1852–56, but engaged in the commission business in Milwaukee in 1856–63; and later became the head of the pork

packing firm of Armour, Plankinton & Co., which was transferred to Chicago in 1870 and reorganized under the firm name of Armour & Co. Its business increased rapidly and it exported its products to every land. It also invested in the refrigerator car service and in the storage and handling of grain. Armour became noted for his philanthropy as well as for his astonishing business ability. He founded the Armour Mission and the Armour Institute of Technology (q.v.), both in Chicago; the former at a cost of about $250,000 and the latter with an endowment of $1,500,000, subsequently increased. His philanthropic work has been carried on and extended by his son, Jonathan Ogden Armour (q.v.).

ARMOUR INSTITUTE OF TECHNOLOGY.—This institution was founded in 1892 by Mr. Philip Danforth Armour of Chicago. The work of instruction was begun in September 1893. The aim of the Institute was expressed in its first public announcement as follows: "This institution is founded for the purpose of giving to young men an opportunity to secure a liberal education. It is hoped that its benefits may reach all classes. It is not intended for the poor or the rich, as sections of society, but for any and all who are earnestly seeking technical education. Its aim is broadly philanthropic. Profoundly realizing the importance of self-reliance as a factor in the development of character, the founder has conditioned his benefactions in such a way as to emphasize both their value and the student's self-respect. The Institute is not a free school; but its charges for instruction are in harmony with the spirit which animates alike the founder, the trustees and the faculty; namely, the desire to help those who wish to help themselves." Four-year courses in mechanical and electrical engineering were first organized. A union was effected with the Art Institute of Chicago for the purpose of developing the course in architecture which that institution had successfully maintained since 1889. The result was the establishment in 1895 of the Chicago School of Architecture. In 1899 the course in civil engineering was added; in 1901, the course in chemical engineering; in 1903, the course in fire protection engineering, and in 1911, the course in industrial arts. The courses now offered in mechanical engineering, electrical engineering, civil engineering, chemical engineering, fire protection engineering, architecture and industrial arts, all lead to the degree of Bachelor of Science.

ARMS. History.—When the naked savage found himself face to face with the wild beast, hungry and fierce, but not within striking distance, he swiftly seized a jagged fragment of rock from the ground and hurled it with all his force at the blazing eyes before him; then another and another, until the beast, dazed from the unexpected blows, fell back and gave him a chance to escape. At that moment the savage *had invented arms and ammunition*. He had found a way to strike a harder blow than the blow of his fist, at a greater distance than the length of his arm, and his brain showed him how to do it. The cave man and his descendants learned the valuable lesson of stone-throwing and it made hunters of them, and so it went on for centuries. At last, however, there appeared a great inventor—a nameless Edison of his day. He took his girdle of skin and placed a stone in its centre, holding both ends with his right hand. He whirled the girdle twice around his head, then released one end so that the leather strip flew out and the stone shot straight forward. Here was the first slingman in action. A little practice made expert marksmen, and most of the early races used it for hunting and in war. We find it shown in pictures made many thousands of years ago in ancient Egypt and Assyria. We find it in the Roman army, where the slingman was called a "funditor." We find it in the Bible, where it is written of the tribe of Benjamin: "Among all these people there were 700 chosen men left-handed; every one could sling a stone at an hair breadth and not miss." Likewise the story of David and Goliath is remembered, when the young shepherd "prevailed over the Philistine with a sling and with a stone." Slings were used in European armies until nearly 100 years after America was discovered.

A little later we find man armed with his "bow and arrow" as an instrument of war. The cross-bow, the Chinese repeating cross-bow, the ballista and catapult, all played their parts up to the invention of gunpowder, when firearms were born, and we have the rapid development of the cannon, the petronel, the hand-culverin, the match-lock, the serpentin, the harquebus, the wheel-lock, the Monk's gun and flint-lock.

It is doubtful at what time guns were first used as sporting arms; but early French and Italian works seem to indicate the close of the 14th century. We find a curious illustration in an old manuscript entitled, "Ye Gonne and How to Use It," dated 1446. This curious sketch is evidently a caricature; but it is sufficient to show that all firearms were used for game shooting in the early part of the 15th century. We have notices of the same in several records of that century, and by the close of the 16th century the gun seems to have become so general a sporting weapon as to necessitate special regulations in several European countries. About 1580, an Italian work informs us, shooting at birds flying and animals in motion was first practiced; but this could not have been to any great extent. It was not until the close of the 18th century that shooting on the wing became at all common. Since that time it has been so universally practised as to make shooting at any fixed object with a shot-gun unsportsmanlike.

Breech-Loaders.—Sporting arms may be classed as shot-guns, pistols, carbines and rifles. Muzzle-loaders are but little used at the present time. Most breech-loaders employ the metallic case cartridge, and are divided into simple breech-loaders and repeaters. The essential parts of all such arms are the barrel, the chamber, the breech-mechanism, the lock, the stock, the sights and the mountings, and in repeaters, the magazine. If the chamber be made in the piece which closes the breech, commonly called the breech-block, the arm is said to have a movable chamber. The latter has great advantages and is generally used. With the fixed chamber the interior of the barrel is divided into two distinct parts, viz., the bore proper or space through which the projectile moves

under the influence of the powder and the chamber in which the charge is deposited. The principal parts peculiar to breech-loaders are: (1) The movable breech-block, by which the chamber is opened and closed; (2) the breech-frame, upon which the breech-block is mounted and united to the barrel; (3) the chamber, with its recess, to receive the rim of the cartridge; (4) the firing-pin, which transmits the blow of the hammer to the cartridge; (5) the extractor, by which the empty case is removed after firing.

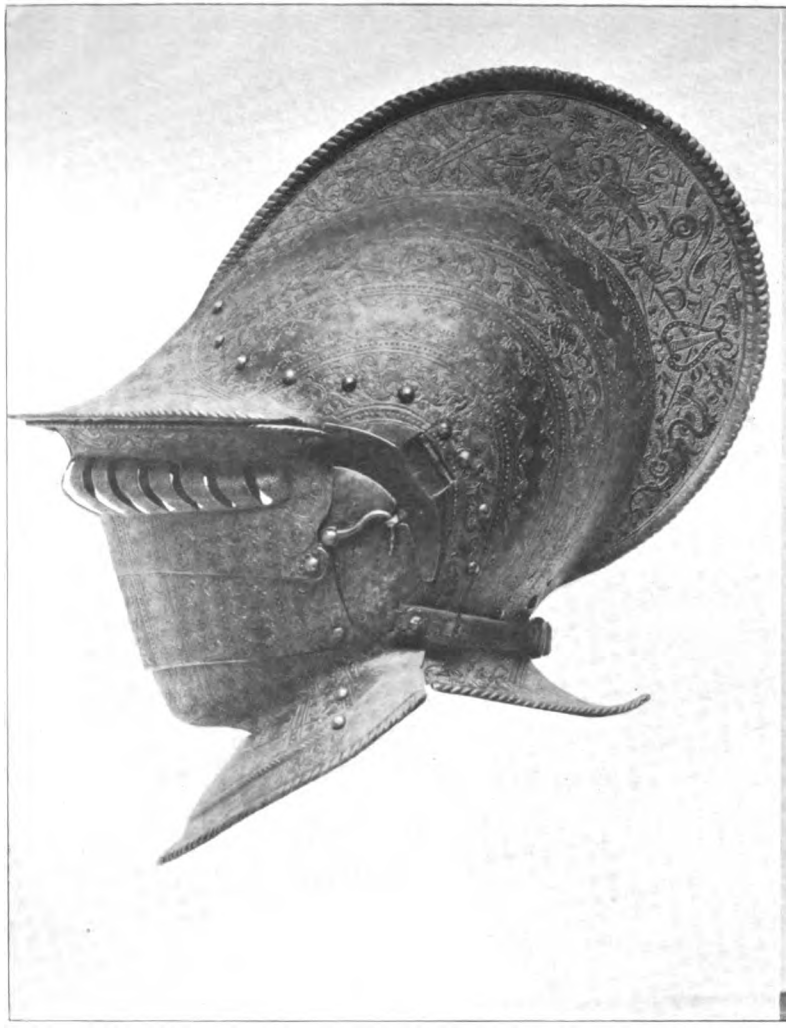
The foregoing named parts may be said to be essential to all breech-loading arms in which the metallic cartridge is used; the different ways in which they are combined mark the systems. These combinations have reference chiefly to the modes of operating and locking the breech-lock. The different systems may be classified into: (1) those with a fixed chamber; (2) those with a movable chamber. The latter have now become obsolete. The first class have (1) a movable barrel; (2) a movable breech-block. With each the motion may be sliding, in which case it moves in grooves; rotating when it swings on a hinge; or sliding and rotating combined. The greater number of systems belong to the class of a "movable breech-block rotating about an axis." In arms of this class the axis of motion may be parallel to the axis of the barrel, and above, below, or to one side of it; or perpendicular to that axis, being vertical or horizontal, and lying in or out of the plane of the axis. The position of the hinge has an important influence on the facility of operating the block, inserting the cartridge, and extracting the empty shell; the most suitable position is deemed to be in front of the centre of the block. In this case the motion of opening and closing the block is natural and easy; the cartridge is pushed into its place by the block, and a very simple retractor serves to withdraw the empty shell after firing. The most serious defect found in breech-loading arms was the escape of the flame through the joint, which not only incommoded the shooter, but, by fouling the machinery, seriously interfered with its operation. At present this is entirely overcome by the elastic metallic case of the cartridge. The advantages of breech-loading over muzzle-loading arms are (1) greater certainty and rapidity of fire; (2) greater security from accidents and loading; (3) the impossibility of getting more than one cartridge into the piece at the same time; (4) greater facility of loading under all circumstances, and particularly when the soldier is mounted, lying on the ground or firing from behind any cover.

The Barrel.— There are certain functions performed by, and certain important conditions to be fulfilled in the construction of, the different portions of a small-arm. The barrel is by far the most important part, its office being to concentrate the force of a charge of powder on a projectile, and give it proper initial velocity and direction; for these purposes, and for the safety of the firer, it should be made of the best material and with the greatest care. In determining the exterior form, it is not only necessary to give such thickness to the different parts as will best resist the explosion effect of the charge, but such as will prevent it from being bent when subject to rough usage. Weight, to a certain extent is necessary to limit recoil, to give steadiness to the barrel in aiming, and to prevent it from "springing" in firing. The latter defect generally arises from bad workmanship, whereby there is a greater thickness of metal and consequently less expansion on one side of the bore than on the other.

Calibre.— Three points are to be considered in determining the calibre of small arms: (1) it should be as small as possible to enable the hunter or soldier to carry the greatest number of cartridges; (2) to diminish the amount of ammunition required, and to prevent the confusion liable to arise from a variety of calibres, there should not be more than two for all arms of the same service, viz., one for the rifle and the carbine, and one for the pistol; (3) this point relates to the force and accuracy of the projectile, and to the flatness of its trajectory. The introduction of the elongated projectiles afforded the means of increasing the accuracy and range of firearms, without increasing the weight of the projectile, simply by reducing the calibre, which diminished the surface, opposed to the air. Too great reduction of calibre, however, gives a very long and weak projectile; and besides, the effect of a projectile on an animate object depends not only on its penetration, but also on the shock communicated by it to the nervous system, or upon the surface of contact. These considerations have led to a general reduction of calibre of rifles.

Grooves.— The grooves being for the purpose of communicating a rotary motion to the projectile around an axis coincident with its flight, their construction will depend upon the form, dimension and material of the projectile, charge of powder, and angle of fire. The points to be considered in determining the form of grooves for arms are range, accuracy of fire, endurance, and facility of cleaning the bore. Experiment has shown that for breech-loaders these points are best attained by making the grooves broad and shallow, and with a rapid twist. The chamber being a receptacle for the charge, its shape is made to conform to that of the cartridge. Its diameter is made a little larger, and that of the bore a little smaller than that of the projectile. This facilitates the insertion of the charge, and causes the projectile to be compressed and held firmly by the bands in its passage through the bore. The bottom of the grooves and the surface of the chamber are generally continuous.

Breech-Mechanism.— The breech-mechanism comprises the principal parts that are peculiar to arms loading at the breech. The functions of these parts are the opening, closing, and locking of the breech, firing the charge and removing the empty cartridge shell. These are the objects for the accomplishment of which the different systems are variously contrived, and with which alone they are concerned. The most important conditions to be fulfilled in the arrangement of this mechanism are: (1) the number of parts should be as few as possible, and all should be of the simplest construction; (2) the strength and union of the parts should be such as not only to resist repeated discharges, but the bursting



Burgonet, French, 1550

Armor for Man and Horse, Italian, 1575

of a cartridge case, which sometimes occurs from defective material or workmanship; (3) the locking of the breech-block should not only be secure, but all the parts by which it is effected should work freely without sticking; (4) the parts should be so arranged that the hammer cannot strike the firing-pin until the breech-block is properly locked; (5) the hammer should not necessarily rest on the firing-pin when the piece is carried loaded; (6) the breech should be unlocked without the hammer being brought necessarily to full cock; (7) the working parts should, as far as possible, be covered from dust and water; (8) the extractor should be so arranged as to require no cuts or openings in that part of the chamber which surrounds the body of the cartridge case.

The Lock.— The lock is the machine by which the charge in the cartridge is ignited. Those of the present day belong to the percussion class, in which fire is produced by a blow upon the fulminating powder, contained in the cartridge case. Locks are divided into side and centre locks, depending upon the position occupied in the stock; each of these may be either front action, wherein the main-spring is in front of the tumbler or back-action, where the spring is in rear of the tumbler. The mortise, which forms a bed for the lock of the latter construction, seriously affects the strength of the stock at the handle, and for this reason the front-action lock is generally preferred for all arms, except revolvers. The conditions to be fulfilled in the construction of a lock are simplicity, strength, certainty of action, and freedom from such accidental motion of the parts as might produce explosion of the charge in the barrel.

The Stock.— The stock is the wooden part of the firearm, to which all the parts are assembled; it is preferable that it should be in one piece. The material should be light, strong, and well seasoned. The butt, the part intended to rest against the shoulder and to support the recoil of the piece, should be of such length and shape as will enable it to transmit the recoil with the least inconvenience to the sportsman. The longer it is, to a certain extent, the more firmly will it be pressed against the shoulder, and the effect of the recoil will be a push rather than a blow. The stock is crooked at the handle for convenience in aiming, and for the purpose of diminishing the direct-action of the recoil. Changing the direction of the recoil in this manner causes the piece to rotate around the shoulder; but if the stock be made too crooked, the butt will be liable to fly up and strike the face.

The Sights.— The sights are guides by which the piece is given the elevation and direction necessary to hit the object. They are two: called front and rear sights. The front sight is fixed to the barrel near the muzzle. The fineness of its point is regulated by the length of the barrel, or distance from the eye, and the size and distance of the object generally aimed at. It is made coarser in military than in sporting arms, to prevent injury. The rear sight is attached to the barrel a short distance from the breech; it has a movable part, capable of being adjusted for different elevations of the barrel. A sight should satisfy the following conditions, viz. (1) it should be easily adjusted for all distances within effective range: (2) the form of the notch should permit the eye to catch the object quickly; (3) it should not be easily deranged by accidents. Globe and telescopic sights are used for very accurate sporting arms, but they are too delicate in their structure and too slow in their operations for general purposes.

The Mountings.— The mountings may be divided into two classes, viz. (1) those which serve to connect the principal parts, generally bands and screws; (2) those which protect from wear or strengthen the stock at certain points, as the butt-plate, guard-plate, tup; (3) the minor parts which secure the different parts (including the mountings proper), in their place, consisting of springs, screws, rivets, pins, washers and nuts.

Modern Instruments.— Trench warfare has created absolutely new conditions and has brought into use new weapons, revived old ones, and brought forth new methods in their use. The use of cover in connection with increased fire effect has greatly increased the power of the defense. The attack will not succeed unless the defense has first been completely shaken. Never before has human ingenuity been so taxed to devise and supply so many murderous instruments of combat.

The modern sabre, bayonet and lance are the successors of the ancient instruments of a similar nature appearing in the Stone, and later in the Bronze and Iron ages. Scottish regiments have used the dagger; Indian troops, the throwing knife, a successor to the javelin. The modern rifle represents the culmination of the same idea found in the sling-shot, later in the bow and arrow, and in the cross-bow. Another variation is the aero-arrow used by the French and English. The revolver is the successor of the pistol. The flat trajectory of the modern rifle has brought about the use of new means to reach troops under cover. The ancients used the ballista and the catapult. The first mortars used also fired stone projectiles. The modern howitzers resemble in their ballistic properties the first guns that were used. Large calibre mortars have been developed, such as the 42 centimetre mortars. Their life is very short. The machine gun is the successor to the Gatling gun. The use of trench mortars and hand grenades dates back to the 16th century. The Japanese were the first to revive their use. See ARMS AND ARMOR; ARTILLERY; CANNON AND SMALL ARMS.

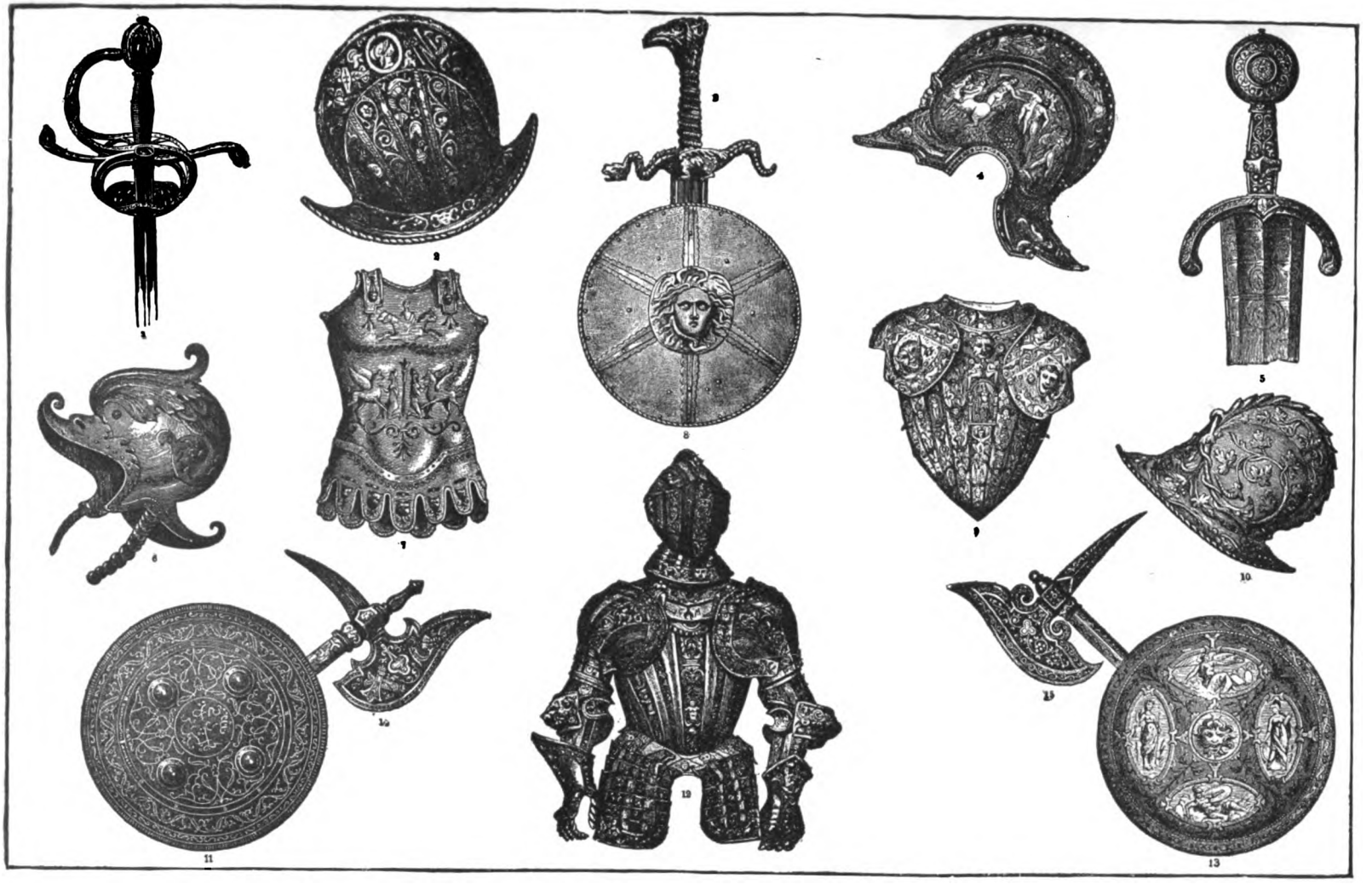
EDWARD S. FARROW,
Consulting Civil and Military Engineer.

ARMS, Stand of, the outfit of arms necessary for the equipment of a single soldier including rifle, bayonet, cartridge box and belt. The term is fast becoming obsolete.

ARMS AND ARMOR. The earliest arms were everywhere made of stone. Stone was succeeded by bronze in the manufacture of weapons of war. The commonest warlike relics of the bronze age that have come down to us are daggers and spear-heads. From the descriptions of Homer we know that almost all the Grecian armor, defensive and offensive, in his time was bronze, although it is evident that iron was sometimes used in the time of Homer for making weapons, from the fact that

he occasionally uses the Greek word for iron (*sidēros*) for a sword. Not the sword, however, but the lance, spear and javelin, were the principal weapons of this age among the Greeks. The bow is not often mentioned, although a bow belonging to Pandarus is described in the Iliad, and in the Odyssey, Ulysses is represented as very expert in the use of this weapon. Among the most ancient nations the Egyptians seem to have been most accustomed to the use of the bow, which was the principal weapon of the Egyptian infantry. The Egyptian bow was somewhat shorter than the height of a man; the arrow was usually made of reed, the head of bronze, but sometimes of flint. Peculiar to the Egyptians was a defensive weapon the object of which was to catch and break the sword of the enemy. With the Assyrians also the bow was a favorite weapon; but with them lances, spears and javelins were in more common use than with the Egyptians. Most of the large engines of war, chariots with scythes projecting at each side from the axle, catapults, and ballistæ, seem to have been of Assyrian origin. All of those mentioned can at any rate be traced back to the Assyrians, to whom the invention of the catapult and the ballista was attributed by classical writers. During the historical age of Greece the characteristic weapon was a heavy spear from 21 to 24 feet in length. The sword used by the Greeks was short, and was worn on the right side. The Roman sword was of Spanish origin, from 22 to 24 inches in length, straight, two-edged, and obtusely pointed, and as by the Greeks was worn on the right side. It was used principally as a stabbing weapon. On the Trajan column, belonging to 114 A.D., the sword appears considerably longer than that used at an earlier period. The Roman sword was originally of bronze, but like all other offensive weapons among the Romans was always of iron in the time of Polybius (2d century B.C.), when bronze continued in use only for defensive armor. The characteristic weapon of the Roman soldier was the pilum, a kind of pike or javelin, about five or six feet in length, with a wooden shaft and an iron head, the latter of which was about one third of the length of the whole. The pilum was sometimes used at close quarters both as an offensive weapon and as a means of parrying blows, but more commonly it was thrown along with the other javelin, which every Roman spearman (hastarius) carried when within 10 or 15 paces of the enemy. The pilum, when thrown from this distance, would fix itself in the enemy's shield, whereupon the Romans would rush up, and seizing hold of the shafts of their pila draw down the shields in which they were fixed, and follow up the attack with their swords. In addition to the large engines of war that have been already mentioned as of Assyrian origin (scythe-chariots, catapults, and ballistæ) the Romans made use of battering-rams for making breaches in the walls of fortified places. The Greeks are said to have used a sort of cannon made on the principle of the modern air-gun. The Romans also employed caltrops to embarrass the movements of an enemy's cavalry.

The principal pieces of defensive armor used by the ancients were shields, helmets, cuirasses, and greaves. No shields were carried by the Egyptian archers; but the Egyptian spearmen had large shields, rectangular below and semi-circular at the top, and with a round sight-hole in this semicircular part. In the heroic age of Greece the shield is described as of immense size, so as to be capable of defending the whole body. In the early monuments the shield is still large, though not so large as it appears to have been in the heroic age. In shape it is round or oval, with a very considerable degree of convexity. At the time of the Peloponnesian War a still smaller shield came into use. The Romans had two sorts of shields — the *scutum*, a large, oblong, rectangular, highly convex shield, carried by the legionaries — and the *parma*, a small, round or oval, flat shield, carried by the light-armed troops and the cavalry. In the declining days of Rome the shields became larger and more varied in form. The helmet was a characteristic piece of armor among the Assyrians, Greeks, Etruscans, and Romans. Like all other body armor it was usually made of bronze. The Assyrian helmet was frequently conical. Sometimes it had the form of a truncated cone, and sometimes the pointed extremity was curved forward. The helmet of the historical age of Greece was distinguished by its lofty crest, which tapered downward to the back of the neck. The Etruscan helmet was also very high crested and sometimes had a wing rising to a considerable height on either side from points near the summit. The Roman helmet in the time of the early emperors fitted close to the head and had a hollow neck-guard and hinged cheek-pieces fastened under the chin, and a small bar across the face for a visor. The neck-guard and cheek-pieces were not peculiar to the Roman helmet, but were in common use wherever the helmet was worn. In later days the helmet of the Romans had a higher crown than that of the early emperors. The cuirasses of the Assyrians were close-fitting tunics made of several layers of flax plaited or interwoven and glued together. This kind of cuirass was introduced into Greece during the Peloponnesian War and was sometimes used even by the Romans. Before the Peloponnesian War the Greeks had the upper part of their body defended by bronze cuirasses. The defensive body armor of the Egyptian archers consisted of a quilted coat. The Egyptian spearmen had cuirasses of bronze scales or quilted with bands of metal. Under the Roman republic all the legionaries wore a bronze cuirass, consisting of a breast and back plate, with a border of pendent leather straps defending the lower part of the body. On the columns of Trajan and Antonine this cuirass is given only to officers, the legionaries wearing at that period only leather or linen cuirasses, on which circular plates of metal and metal shoulder-pieces were sewed, and to the lower border of which were attached oblong plates which served the purpose of the leather straps of the other cuirass. In the time of Trajan and Septimius Severus a flexible cuirass was added to the equipment of the Roman knight or horseman. This was made either of scales (*lorica squamata*) or of chains (*lorica hamata*). One of the latter kind has been found at Avenches in Switzerland, and is there exhibited. Greaves do not seem to have been worn by any of the eastern nations



1 Riding Sword, Seventeenth Century
2 Morion of Italian work, Sixteenth Century
3 Sword Hilt, Sixteenth Century
4 Helmet of Philip II. of Spain: Italian work of Sixteenth Century
5 Sword Hilt of Cæsar Borgia
6 Gold Damascened Helmet of Sixteenth Century
7 Roman Body Armor
8 Shield of Sixteenth Century
9 Breastplate of Philip III. of Spain
10 Casque, Sixteenth Century
11 Oriental Round Shield
12 Body Armor, with Burgundian Head-piece, Sixteenth Century
13 Shield of time of Henry II. of France
14-15 Battle Axes of Sixteenth Century

except the Persians, whose defensive armor resembled pretty closely that of the Middle Ages. The greaves of the Greeks (*knēmides*) were made in two pieces which were fastened together by clasps. The Roman greaves (*ocreæ*) were made in one piece and were often worn only on one leg. The Samnite practice was to wear the greave upon the left leg, which is the leg advanced in fighting with a shield on the left arm; but Vegetius mentions that the greave was worn by the Roman legionaries upon the right leg. The greave reached only from the knee to the ankle. The Roman soldiers had their feet protected by shoes set with nails (*caligæ*).

The favorite weapons of the Germanic races, by which the ancient civilization of Rome was to a large extent overthrown, were the battle-axe, the lance or dart, and the sword. Their defensive armor consisted almost exclusively of a shield made of plaited osier covered with leather and generally eight feet by two inches in size. Afterwards it was made round and bound with iron, and had several prominent bosses on its surface. The Frankish form of the German battle-axe was called *francisca* (francisque), and was the characteristic weapon of that tribe. It had a broad single-edged blade and a short haft, and was often used as a missile. The lance or dart of the Franks, called *angon*, closely resembled and was used exactly in the same way as the Roman pilum. The sword among the Franks was only a horseman's weapon. The shield of the Franks was round. Hardly any body armor (scarcely even a helmet) was used by them until the Carlovingian days. Swords belonging to the early iron age in Scandinavia are frequently found in the marshes of Schleswig. They are long, straight, two-edged, and often richly damascened. Shields belonging to the same district and epoch were made of wood, and were flat, round, and from 22½ to 44 inches in diameter. They were bossed and otherwise mounted, generally in bronze, sometimes in iron. The common arms of the Anglo-Saxon infantry were a spear, and axe, and a scramasaxe (a heavy single-edged knife). With the Anglo-Saxons as with the Franks the sword was especially a horseman's weapon, being carried by none under the rank of thane. The sword carried by them was three feet long, broad in the blade, and round at the point. The Saxon shield was round or oval, made of wood covered with leather, and furnished with a high conical boss.

The arms and armor both of the Normans and Anglo-Saxons, but especially of the former, at the time of the Norman conquest of England are pretty fully illustrated by the Bayeux tapestry. On this work the horsemen appear armed with long lances as well as swords. The Normans are represented as well furnished with archers and cavalry, of which arms the Saxons do not seem to have had any. Maces, clubs, axes with shafts from four to five feet long, are seen in the hands of both. The shields are long, rounded above and tapering to a point at the bottom. The body-armor consists of a long hauberk ringed or trellised. The helmet is conical and has a sort of tongue in front which comes down over the nose.

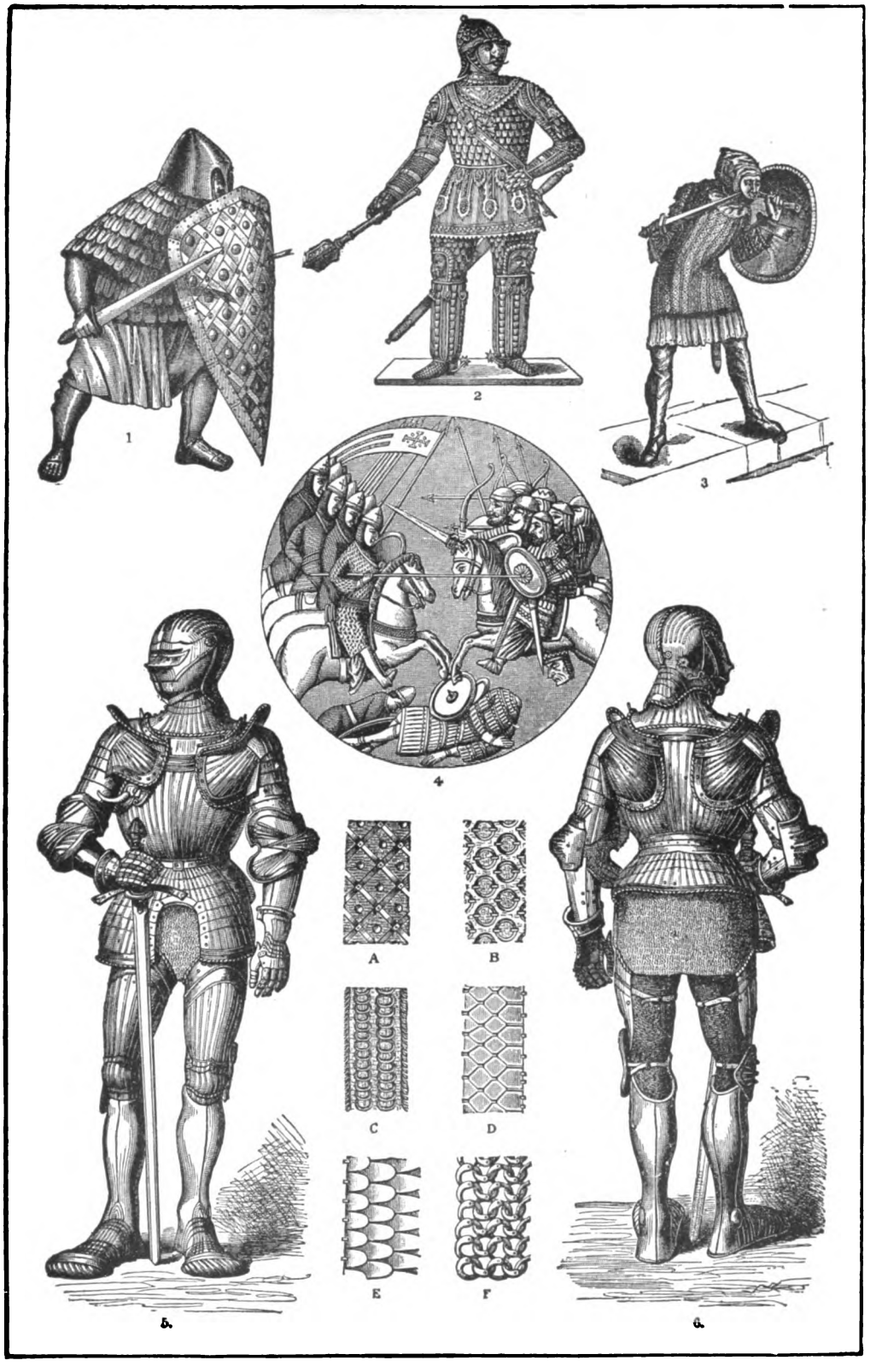
Chain armor of interlinked rings came into use at the time of the Crusades and continued in use till the beginning of the 14th century. From the latter date to early in the 15th century mixed chains and plate armor was in use, and from about the year 1410 to the beginning of the next century the body armor was entirely of plate, and complete suits of plate armor did not altogether go out of use for another century. Below the waist the body was protected by taces, a series of narrow overlapping plates attached to a lining of leather. After the introduction of complete suits of plate armor the chief modifications consisted in the strengthening of the weakest parts, especially on the right side. By the end of the 15th century plate armor had attained its highest development, even the horses at that period being protected by plate armor everywhere except on the legs. By this time, in fact, the fabrication of armor had reached such a degree of perfection that it was scarcely possible for men-at-arms engaged in combat to find any spot where the armor of their antagonist could be pierced. Combatants equipped in this manner aimed accordingly less at wounding than at unhorsing one another, for a man-at-arms unhorsed was at the mercy of his antagonist, who, if he could not find any weak point where he could pierce the armor of his fallen foe, might beat him to death with the heavy mace with which he was armed. Many savage encounters of this nature are recorded by the chroniclers of the time. Usually, however, a man-at-arms when unhorsed became the prisoner of his conqueror, and many battles were decided, especially in the wars between the states of Italy, carried on by means of mercenaries, almost or altogether without the shedding of blood either on the side of the vanquisher or the vanquished. When body-armor had come to be manufactured with such perfection shields were almost entirely discarded. In England, indeed, no effigy has been found representing a man-at-arms bearing a shield of later date than the last quarter of the 14th century, from which it would seem that that defense had gone out of use even before the adoption of complete suits of plate armor. Perhaps the most characteristic portion of the body-armor of the 15th century was that which protected the feet. The coverings for the feet during this period were laminated *sollerets* (as they were called), actually pointed or rounded off at the toes. In the following century these were succeeded by *sabbatons*, cut off square at the toes. In this century the armor gradually became less rigid and cumbrous, and often consisted of small plates of metal quilted within linen or other tissues. As the century advanced the manufacture of body-armor declined, and after the close of the century armor was worn as much for show as for real service. Metal cuirasses gave place, as a rule, to buff suits and jerkins, although the former armor is not entirely disused even at the present day. The principal weapons of the man-at-arms were the lance, sword, battle-axe, and mace, all of which were remarkable for their massiveness, as might be expected from the resistance they had to meet. The lance (see LANCE and TOURNAMENT) was the weapon which he used to unhorse his antagonist if he could not wound him with it. Two-handed swords were in common use in the 16th century. The sword-breaker, consisting of a deeply notched blade

about 15 inches in length, and intended to catch and break the sword of an antagonist, belongs to the same period.

During all the time that the use of heavy armor prevailed, the horsemen, who alone were so armed, formed the principal strength of armies; and so much was this the case that infantry were generally regarded as of hardly any account. An exception must, however, be made in the case of England, the archers of which were almost at all times, before the invention of gunpowder, an important and sometimes the chief force in the army. It has been already mentioned that the Bayeux tapestry furnishes us with evidence of the fact that the Normans were provided with archers at the time of the conquest. The bows used by them were small, being little more than a yard in length. The deadly weapon afterward used by the English archers was from five to six feet in length, and the arrow discharged from it was itself a yard long. The bow used in Germany as well as that used in Italy (where steel was the material of which it was usually made) was about a yard and a half long. There is no evidence of the cross-bow having been used before the 11th century. Its use against Christians was forbidden by the Council of the Lateran in 1139. The long-bow continued in general use in England till the end of the reign of Elizabeth, and even as late as 1627 there was a body of English archers in the pay of Richelieu at the siege of La Rochelle. The cross-bow did not go out of use in the French army till the 17th century. Among the other hand-arms in use before the invention of gunpowder were the sling and the fustibale, which was nothing else than a sling with a handle to it. The large engines of war used in the Middle Ages were the same as those that had been employed by the Romans, with only slight modifications. A coat made of leather or quilted stuff, called in French *gamboison or gambeson,* was almost the only defensive armor of the foot-soldier during the greater part of the period of which we are now treating.

The use of gunpowder as a means of discharging projectiles and the gradual improvement of firearms effected in course of time a complete change in all the methods and accessories of warfare. Details regarding the construction and recent improvements of large and small firearms and projectiles will be found under BOMB, BULLET, CANNON, GUN, MUSKET, RIFLE, SHELL, etc. Gunpowder was not used in Europe to discharge projectiles till the beginning of the 14th century. Cannon are first mentioned in England in 1338, and there seems no doubt that they were used by the English at the siege of Cambrai in 1339. All early cannon were breech-loaders. In the oldest form the breech consists of wedges of wood or metal and this form was succeeded by cannons with movable breech-piece. The projectiles first used for cannon were of stone. Field-guns were introduced in the course of the 15th century. A rifled cannon of the 15th century is to be seen in the museum of The Hague. Mortars were introduced into the French army in 1634. Hand firearms date from the 15th century. The Swiss at the battle of Morat in 1476 are said to have been provided with 6,000 arms of this kind. In England the yeomen of the guard were armed with them in 1485. At first they required two men to serve them, and it was necessary to rest the muzzle on a stand in aiming and firing. Lighter hand-firearms called petronels seem to have been first used by cavalry. Hand-firearms were at first fired in the same way as cannon, by means of a slow match carried in the hand and applied to the powder at the touchhole. The first improvement was the invention of the matchlock about 1476. In the matchlock the slow match was held at the end of one arm of a bent lever attached to the side of the piece in such a manner that by the action of a trigger it could be brought down upon the powder in the pan at the touchhole. This kind of lock was superseded by two others, the wheel-lock and the snaphance, that seem to have been invented about the same time early in the 16th century, although the matchlock continued in use long after that date, and indeed was not altogether abandoned till the beginning of the 18th century. The wheel-lock is generally said to have been invented at Nürnberg, and was largely used in Germany. It consisted of a steel wheel which was made to revolve by a spring, and in revolving struck fire from a flint, and at the same time lifted a cap which kept the powder in the pan from being wet by rain or blown away by the wind. The chief objection to it was that it was slow in its operation, as the spring had to be wound up every time it was used. The snaphance was largely used in the Spanish dominions. It was the immediate predecessor of the flintlock, from which it differed only in making the flint strike against a fixed upright piece of iron in front of the powder-pan, while in the flintlock this upright piece was attached to another piece that covered the pan and which turned on a hinge, so that when the flint descended and struck sparks from the iron it at the same time uncovered the pan. The flintlock was invented in France about 1640, and gradually came into universal use, until it was itself superseded by the percussion-lock. This last was patented by a Scotch clergyman named Alexander Forsyth in 1807, and had been adopted everywhere by the year 1820. The first model of the needle-gun was made in 1827 by J. N. Dreyse of Erfurt. It was first made breech-loading in 1836. The only important weapon not a firearm that has been invented since the introduction of gunpowder is the bayonet, which is believed to have been invented about 1650. The socket-bayonet, fitted round the muzzle of the gun, was introduced into the French army by Vauban.

The earliest collection of arms and armor was that made by Louis XII, at Amboise in 1502. There is a fine collection at Dresden, begun in 1553. Among others may be mentioned the collection in the Metropolitan Museum, New York, recently augmented by the acquisition of the celebrated Riggs collection, which makes the New York collection one of the finest in the world. The Riggs lot contains about 2,500 separate pieces, many of historic interest as well as of artistic importance; the Ambras collection, commenced in 1570, now at Vienna, and those at Turin, Sigmaringen, Tsarsko-selo, Petrograd, Madrid and in the Tower of London. The last mentioned was classified by Dr. Meyrick and catalogued by J. Hewitt. The Antiquarian Museum of Edin-



1 French Foot Soldier, Eighth Century
2 Polish Knight, end of Fifteenth Century
3 French Soldier, about 1120 A. D.
4 Battle of Askalon (1099) from a Window in the Church of St. Louis, Paris

5–6 German Full Armor, of the time of Maximilian I
A Mottled or Striped Armor. B Ringed Armor. C Fettered Armor. D Shield Ornament. E Flate Armor. F Chain Armor

burgh is rich in weapons of the stone and bronze periods, but has few specimens of arms and armor of more modern times. Of works specially devoted to the subject of arms and armor the most worthy of mention are Grose, 'Treatise on Ancient Armor and Weapons' (1785–86; Supp. 1789; afterward annexed to the second edition of the same author's 'Military Antiquities,' 1801), and Meyrick, 'Critical Inquiry into Ancient Armor as it existed in Europe, but particularly in England, from the Norman Conquest to the reign of King Charles II' (1824). An excellent compendium on the subject by Auguste Demmin was published in 1869 in French, English and German. The title of the English edition is 'Weapons of War'; it gives a history of arms and armor from the earliest period to the present time. Consult also Dean Bashford in 'Bulletin of the Metropolitan Museum' (Vol. IX, New York 1914); id., 'Arms and Armor' (ib. 1915).

EDWARD S. FARROW,
Consulting Civil and Military Engineer.

ARMSTEAD, Henry Hugh, English sculptor and worker in metals: b. in London 1828; d. 1905. He studied at the School of Design and later in the Royal Academy Schools, Somerset House, and at first was much influenced by the elegance of his instructor, E. H. Bailey. He presently exhibited greater insight and was employed by Sir Gilbert Scott to execute portions of the Albert Memorial, London. A noted portrait statue sculptured by him is that of Bishop Wilberforce in the north transept of Winchester Cathedral. Other marble effigies by him will be found in Westminster Abbey. Consult biography by his daughter (1906).

ARMSTRONG, Andrew Campbell, American educator: b. New York City, 22 Aug. 1860. After graduating from Princeton University in 1881 he entered Princeton Theological Seminary. Having finished his four-years' course he went to Berlin, there to take a post-graduate course in Berlin University. He was then appointed associate professor of ecclesiastical history at Princeton Seminary. Two years later he became instructor in history at Princeton College, but a year later was called to Wesleyan University. From 1904 to 1909 he was co-operating editor of the *Psychological Review.* Aside from his many articles on psychological and philosophical subjects, he has written 'Transitional Eras in Thought' (1904), and has translated Falckenberg's 'History of Modern Philosophy' (1903).

ARMSTRONG, David Maitland, American artist: b. Newburgh, N. Y., 15 April 1836. He was graduated from Trinity College, Hartford, A.B.A.M. 1858, was a member of the New York Bar, practised law in New York six years, and studied art in Rome and Paris. He was a pupil of Luc Olivier Merson, United States Consul General for Italy at Rome 1869–72, Director of American Art Department, Paris Exposition, 1878 and Chevalier of the Legion of Honor of France. He is associate member of National Academy of Design, of the Architectural League and other art societies, National Society of Mural Painters, Century Club, Trustee New York Society Library. He and his wife constitute the heads of the firm of Maitland Armstrong & Co., designers and makers of stained glass. Many hundred important memorial and other windows in various parts of the United States and Canada have been designed by them.

ARMSTRONG, Edward, English educator and historian: b. Grahamstown, South Africa, 3 March 1846. He is a graduate of Exeter College, Oxford, where he took his final examinations in 1869. During the following year he served as tutor at Queen's College, when he was appointed assistant master at Rugby. In 1873 he returned to Oxford. From 1878 to 1911 he was bursar at Queen's College and lecturer on modern history; while in the university he was lecturer on foreign history and a member of the board of finance. Since 1910 he has been warden of Bradfield College. Among other positions he held was that of curator of the Taylor Institute and the Botanic Gardens. His writings in book form are 'Elisabeth Farnese' (1892); 'Lorenzo de' Medici' (1897); 'The Emperor Charles V' (2 vols., 1902); 'The French Wars of Religion' (2d ed., 1904).

ARMSTRONG, Edward Cooke, American educator: b. Winchester, Va., 24 Aug. 1871. Graduating from Randolph-Macon College in 1890, he took a post-graduate course at Johns Hopkins and was accorded a degree of PhD. in 1897. Later he took up studies at Paris and Berlin. In 1897 he became professor of the French language at Johns Hopkins, and in 1910 chairman of the Romance department.

ARMSTRONG, George, called the "Father of the United States Railway Mail Service": b. Armagh, Ireland, 27 Oct. 1822; d. Chicago 5 May 1871. His parents came to the United States when he was eight years old and settled in Baltimore. He entered the postal service in Washington when a young man, and his ability won him promotion in 1854 to assistant postmaster at Chicago. He then made a study of mail transportation, wrote exhaustively on the subject, and in July 1864 was given authority by Postmaster-General Montgomery Blair to experiment on any railroad he might select. The first trial took place on the Northwestern Railroad 28 Aug. 1864, between Chicago and Clinton, Iowa, and was a complete success. He was the head of the service from the start but was assigned to headquarters in the West with general supervision of the service in the East. In 1869 President Grant directed that a bureau be made of the railway postal service, and placed Amstrong at the head as general superintendent, a position which he held until his death two years later. A bronze statue in memory of his work was erected in the post-office building, Chicago, in May 1881. See POSTAL SERVICE IN COMMERCE.

ARMSTRONG, John, American soldier: b. Ireland 1725; d. Carlisle, Pa., 1795. In 1756 he was the leader of a successful campaign against the Indians at Kittanning, Pa. In 1776 he was made a brigadier-general in the Continental army. He resigned his commission after 13 months and took a similar rank in the militia of Pennsylvania. He commanded this force at Brandywine (11 Sept. 1777) and at Germantown (4 Oct. 1777) and was appointed

major-general in January of the following year. He served as member of the Continental Congress in 1778–80 and in 1787–88.

ARMSTRONG, John, American author and soldier; b. Carlisle, Pa., 25 Nov. 1758; d., Red Hook, N. Y., 1 April 1843. While an undergraduate at Princeton he enlisted in the army and became aide-de-camp to General Mercer, being made a major at the same time. For a time after the close of the war he was successively Secretary of State and Attorney-General of Pennsylvania and in 1787 was sent to Congress from that State. Two years later he married, removed to New York State and in 1800–04 was United States Senator from that State. He was United States Minister to France, 1804–10, and afterward to Spain; and Secretary of War, 1813–14. The failure of the Canada expedition and the capture of Washington were the cause of his becoming very unpopular and he resigned. He wrote the 'Newburg Addresses' in 1783, anonymously, with the intent to arouse Congress to redress army grievances. He also wrote 'Notices of the War of 1812' (1836); memoirs of Generals Montgomery and Wayne in Sparks's 'American Biographies,' and prepared in part a history of the American Revolution. Consult Adams, Henry, 'History of the United States, 1801–17' (New York 1889–90).

ARMSTRONG, Paul, American playwright: b. Kidder, Mo., 25 April 1869; d. 29 Aug. 1915. From 1890 to 1895 he was a licensed master mariner, commanding steamships on the Great Lakes. In 1904 he had produced his first play, 'The Heir to the Hoorah.' Then followed 'Saint Ann' (1904); 'Salomy Jane' (1905); 'In a Blaze of Glory' (1906); 'Via Wireless' (in collaboration with Winchell Smith, 1909); 'Alias Jimmy Valentine' (1909); 'The Deep Purple' and 'The Greyhound' (in collaboration with Wilson Mizner, 1910 and 1911); 'A Romance of the Underworld' (1911); 'The Escape' (1913).

ARMSTRONG, Robert, American soldier: b. Tennessee, 1790; d. Washington, D. C., 23 Feb. 1854. He was an artillery captain in the war with the Creek Indians in 1813, being badly wounded at Taladega. At the Battle of New Orleans, 8 Jan. 1815, he was in chief command of the American artillery, and during the second Seminole War, 1835–37, he was a brigadier-general. In 1845 he was appointed United States Consul at Liverpool, where he remained for seven years, after which he returned home and became proprietor and editor of the Washington *Union*. During this period he was confidential adviser to President Polk.

ARMSTRONG, Robert Allen, American educator: b. Frenchton, Va., (now West Virginia) 23 Sept. 1860. In 1886 he graduated from the West Virginia University after which he took post-graduate courses at Chicago, Columbian (now George Washington), and Harvard universities. He was first appointed principal of the West Liberty State Normal School, during which period he also studied law and was later admitted to the bar. In 1893 he was appointed professor of English at West Virginia University, becoming head of the English department there 10 years later. From 1899 to 1909 he was secretary of the West Virginia Board of School Examiners. In 1904 he became editor of the West Virginia *School Journal*. He is the author of 'Geography of West Virginia,—Supplement to the Natural Geography' (1899); 'Life out of Death' (1906); 'The Law of Service' (1907); 'Dramatic Interpretation of Shakespeare's Tragedies' (1907); 'Mastering the Books of the Bible' (1916).

ARMSTRONG, Samuel Chapman, an American educator: b. Wailuku, Maui, Hawaii, 30 Jan. 1839; d. Hampton, Va., 11 May 1893. He was a son of Richard Armstrong, one of the earliest American missionaries to Hawaiian Islands and founder of their educational system. The son was educated at Oahu College, Honolulu, till 1860, and graduating from Williams College in 1862, at once entered the Union army. He served till the end of the Civil War and was mustered out with the rank of brigadier-general of volunteers. In 1866 Gen. O. O. Howard, who had noted Armstrong's interest in the colored troops, induced him to take a position with the Freedman's Bureau, where he was charged with the oversight of all colored people in 10 Virginia counties. After two years of successful administration, during which he had worked out a careful plan of negro education, he enlisted the aid of the American Missionary Association and personal friends in the North, and founded the Hampton Normal and Agricultural Institute. Its object was to give the negroes practical education, to train teachers, and to render its graduates self-supporting. For 10 years the students were negroes exclusively; then (1878) the United States government, attracted by Armstrong's success, arranged to have Indian children taught there. This experiment has also proved successful. General Armstrong devoted his life to the school and made it the best known and studied one of its kind in the world. At his death it had 100 teachers and employees, 200 Indian and 600 colored students. Consult Ogden, R. C., 'Sketch of Armstrong' (New York 1894).

ARMSTRONG, Sir Walter, British writer and art critic: b. Roxburghshire, Scotland, 1850. After finishing his education at Harrow and at Exeter College, Oxford, he became art critic on the staff of the *Pall Mall Gazette*, the *Saint James' Gazette* and the Manchester *Guardian*. In 1892 he became director of the National Art Gallery, Dublin. In 1899 he was knighted. Among his works are 'The Art of Velazquez' and 'The Life of Velazquez' (1896); 'Art in Great Britain and Ireland' (1909); 'Sir Henry Raeburn' (1901); 'Sir Joshua Reynolds' (1900); 'J. M. W. Turner' (1901); 'Sir Thomas Lawrence' (1913).

ARMSTRONG, Baron, William George, an English engineer and mechanical inventor: b. Newcastle-on-Tyne, 26 Nov. 1810; d. Rothbury, 27 Dec. 1900. He was trained as a solicitor, and practised as such for some time, though his tastes scarcely lay in that direction. Among his early inventions were the hydro-electric machine, a powerful apparatus for producing frictional electricity, and the hydraulic crane. In 1847 the Elswick works, near Newcastle, were established for the manufacture of his cranes and other heavy iron machinery, and these works are now among the most extensive of their kind. It was here that the first rifled ordnance gun which bears his name

was made in 1854. His improvements in the manufacture of guns and shells led to his being appointed engineer of rifled ordnance under government, and he was knighted in 1858. This appointment came to an end in 1863, since which time his ordnance has taken a prominent place in the armaments of different countries. He was raised to the peerage as Baron Armstrong in 1887.

ARMSTRONG-HOPKINS, Saleni, American physician, author and lecturer: b. London, Ont., 21 Jan. 1855. She was educated at the high school, Blair, Neb., and at Northwestern University. She studied medicine at the Woman's Medical College, New York Infirmary and at the Woman's Medical College of Pennsylvania, where she was graduated in 1885. She engaged in social work, taking 13 small waifs from Philadelphia and Chicago to the West, and established them in the homes of farmers in Nebraska. She was one of the founders of the Park Hill Orphan Home, now the Mothers' Jewels' Home, at York, Neb. In 1886 she was sent out to India as a medical missionary by Bishop William Taylor. She was founder of Khetwadi Castle Hospital and the Khetwadi Training School for Nurses at Bombay, 1887–88. In the latter year she was elected national lecturer on heredity by the Women's Christian Temperance Union of Bombay. She was appointed by the British government physician-in-charge of the Woman's Hospital Dispensary and Training School for Nurses at Lahore, India in 1889 and later was made physician-in-charge to the Woman's Hospital Dispensary at Hyderabad, Sindh. She returned to America in 1893, bringing with her six natives of India to be educated as missionaries to their own people. In 1893–95 she was resident physician of the Armstrong-Hopkins Private Hospital for Women and Children at Omaha, Neb., and has since practised medicine and surgery, and lectured and preached in Colorado, Delaware, Virginia and New York. She has published several works, including 'Divine Call to Foreign Missionary Service'; 'Record of Daily Work'; 'Heroes and Heroines of Zion'; 'In the Zenana Homes of Indian Princes'; 'Khetwadi Castle,' etc.

ARMY. Among nations of antiquity all men capable of bearing arms were liable to be called on to serve as soldiers, with the exception of the Egyptians, Indians of Aryan race, and the Israelites. In the first two of these nations the warrior formed a separate class or caste of the community, ranking next in dignity and influence to that of the priests. In Egypt the military caste shared with the king and the priests the whole of the soil. The members of the caste were interdicted from all handicrafts. The Egyptian infantry was mainly composed of archers. Foreign auxiliaries were also employed, but kept in a strictly subordinate position, except under the last native kings of Egypt; and the different policy pursued by them was without doubt in a great measure to blame for the easy conquest of Egypt by Cambyses. In India the members of the warrior caste were called Kshatriyas, and after the complete subjugation of the non-Aryan inhabitants whom they found in the peninsula when it was invaded by them, seem generally to have lived an indolent life. Among the Israelites the only portion of the male population exempt from military service was of the tribe of Levi. In the other tribes all men above 20 might be called upon to serve in the army when occasion required. At first the army of the Israelities consisted entirely of infantry. David introduced charioteers, and Solomon added a regiment of cavalry. In later times an Egyptian auxiliary cavalry is sometimes found serving in the Jewish armies. The beginning of a standing army was made by Saul, who raised a body-guard of 3,000 men. After the captivity a new organization developed itself under the Maccabees. John Hyrcanus raised an army of foreign soldiers, chiefly Arabs.

From the monuments found in the valleys of the Euphrates and the Tigris we learn that at an early date the Assyrians, Babylonians, and Medes possessed armies of infantry, cavalry, and charioteers and divided into light and heavy armed troops, distinguished by dress, equipment, and arms. But is was after the establishment of the Persian empire that the army system of the East attained its highest point of development. When the Persians had extended their empire over almost the whole of western Asia it was necessary to maintain a standing army to keep down conquered tribes and to guard the frontiers. The various sections of this army were each levied in the province to which it belonged, and were partly stationed in fortified towns, partly distributed over the country districts. Their pay was derived from the revenues of the province, but their commanders were wholly independent of the satraps or provincial governors. Yearly reviews were held in order to see that they were constantly kept in a state of efficiency. The troops of the standing army included a light and heavy infantry, as well as strong bodies of cavalry, part of whom were clad in armor. The subdivisions of the army (both cavalry and infantry) were according to the decimal system. Originally all the forces were Persians, but in later times Asiatics and Greeks were also enrolled. Express messengers, stationed throughout the empire at the distance of a day's journey from one another, formed the means of communication between the different parts of the army. In addition to this provincial force the king had a body-guard of 10,000 men, called the immortals, from the fact that their numbers were always kept full. When great expeditions (such as the invasions of Greece) were undertaken a levy of the whole people was made. Fifty-six nations, according to Herodotus, were represented in the levy made by Xerxes for his celebrated Greek expedition.

In the small free states of Greece the armies consisted of a civic militia, in which it was the right and duty of every freeman to serve. In times of emergency the slaves also were armed. The Greek armies often consisted exclusively of infantry. Athens never had more than 1,000 cavalry. The foot soldiers were divided into *hoplitai*, or heavy-armed, whose equipments consisted of a long lance, a sword, and a large shield; *peltastai*, armed with a short spear, and carrying a small round shield; *psiloi*, carrying no shields, and armed only with javelins, bows and arrows, or slings; and *gymnētes*, also without shields, and chiefly composed of slaves and foreigners. The age

for military service was 20 to 40 at Athens and 20 to 60 at Sparta. In Athens, however, every youth was enrolled at the age of 18, although not liable to be called on for active service till he had reached the age of 20. The command of the Athenian army was divided among 10 generals, who were elected for one year, one by each of the 10 Attic tribes, and each of whom had the chief command in turn for one day, when they were all present with the army. To obviate the manifest inconvenience of this arrangement nine of the generals were sometimes left behind, and sometimes one of the archons called the Polemarch took the field, in which case the duties of a commander-in-chief were in a great measure left to him. Until after the Peloponnesian War Athenian soldiers received no pay, but from that date a small pay was given to those in the field. At Sparta the command of the army belonged to the two kings, and usually two armies were formed, each king having the command of one of them. When only one army was formed one of the kings remained at home. Although in Sparta, as in Athens, the army consisted of the free citizens generally, yet, as in the former city it was always kept ready for war, it constituted a kind of standing army. It was divided into five *moras* or regiments, one for each tribe. After the time of the Peloponnesian War it became more and more common for all the Greek states to employ mercenary troops, and the Greeks themselves often entered into foreign service. The Macedonian standing army was created by Philip, and from the time of Alexander was composed chiefly of mercenaries. The Carthaginian armies consisted in large part, and indeed mainly, of mercenaries. The body-guard of the general, called the "sacred band," was, however, entirely made up of Carthaginians by birth, but was distinguished less by its valor than by the splendor of its equipments. In the army of Hannibal, Gauls, Iberians, and Ligurians formed the main force; Numidian cavalry hovered on the wings; Balearic slingers and elephants led by Ethiopian masters were drawn up in front. In Rome every citizen from the age of 17 to 46 was bound to serve in the army till he had made 16 (or in emergencies 20) campaigns on foot or 10 in the cavalry, and no citizen could become a candidate for any magisterial office unless he had been 10 years on foot or 5 mounted. During the best times of the Roman army the troops were selected with great care, and the discipline and training of the legions were admirable, so that the Roman infantry (of which the legions were mainly composed) was the best the world had yet seen. The Roman cavalry, on the other hand, was numerically weak, and was excelled by the Numidian, and still more so by the Parthian. Pay was given to the Roman troops from the time of the siege of Veii (406 B.C.). When the Roman empire in the West fell to pieces, in consequence of the repeated inroads and settlement within its borders of German tribes, there was an end for the time to all regular army organization in western Europe. The forces by means of which the Roman empire had been gradually dismembered consisted, like the Persian hordes that 1,000 years before had conquered western Asia, of armed nations; but a new military organization, greatly inferior, however, to that of the Romans, grew up in process of time out of an institution common to all the German tribes. This was the practice followed by the chiefs of gathering round themselves bodies of retainers constantly ready to fight under them, in the expectation of being rewarded out of the spoils of conquest. As long as the Germans were confined to their original settlements outside the Roman empire these bodies of retainers bore a small proportion to the total strength of the armed population; but when extensive conquests of land were made within the Roman empire more or less of the conquered territory was always seized by the conquerors, and the personal retainers of the conquering chiefs were often so richly rewarded that the retinues of the chiefs were rapidly swelled by the adhesion of those who hoped for equal gain. At first these grants were looked upon simply as rewards for past services, but they soon came to be given and received as pledges of future service, every person receiving a grant being bound to serve his chief in war whenever called upon. In this way the feudal system, as it is called, gradually arose, and feudal armies finally superseded the national levies of the German tribes. When Charles Martel conquered the Saracens at Tours in 732 the transition from national to feudal armies was not yet accomplished, but it was almost completed under Charlemagne at the end of the same century. The chief strength of the feudal armies lay in the men-at-arms, who were all mounted, heavily armed, and protected by shields and defensive armor. After the introduction of firearms, shields and armor ceased to be an effectual protection, personal valor and bodily strength became of less moment, disciplined armies were found to be necessary, and the knights entered these armies as officers. The military forces of the small states that rose up in Italy from the 12th century resembled those of the states of ancient Greece in being at first nothing more than a civic militia. In later times hardly any troops were used, but mercenaries were employed, led by *condottieri*, and these at last were superseded by standing armies.

Among the countries of modern Europe the foundation of a standing army was first laid in France. In 1439 Charles VII of France issued an ordinance called the Ordinance of Orleans for the creation of a number of troops of horse (hence called *compagnies d'ordonnance* or ordinance companies), which were to be maintained by the cities and villages in war and peace. In 1448 the same king established a corresponding body of infantry called *Francs-archers*. Henceforward the feudal militia fell more and more into disrepute, and the vassals assembled their forces only on occasions of great emergency. The example of France was followed elsewhere, and during the wars of Francis I and Charles V at the beginning of the 16th century, France, Germany and Spain were all in possession of considerable standing armies. These armies were all raised mainly by voluntary enlistment, compulsory levies being resorted to only under the pressure of very exceptional circumstances. The usual practice was for the king to contract with some nobleman or gentleman

for the raising of a regiment; but in the Thirty Years' War Gustavus Adolphus set the example of raising all his troops directly for his own service. In this same war, however, a whole army was raised for the emperor by a private gentleman (the celebrated Wallenstein), the emperor engaging to give him the command of it. Gustavus Adolphus was also the author of many reforms in army organization. He established smaller divisions, introduced lighter weapons, separated the pikemen from the musketeers, who had hitherto been mixed together, and made many improvements in the artillery; by all of which changes quicker and more complicated movements became practicable. The soldier was more thoroughly drilled and reduced almost to a machine, while the responsibilities of the officers were increased. The wars of Louis XIV led to further improvements in military organization and tactics, and in a still greater degree to the increase of the size of armies. Instead of the 14,000 men maintained by Henry IV of France, Louis XIV, after the Peace of Nijmegen (1678) had on foot an army of 140,000 men. Armies were likewise increased by all the other powers of Europe except England and Holland, where the strengthening of the standing army was looked on with great jealousy, and till the time of William III continually opposed by the representatives of the people as dangerous to freedom. Among the military powers that came to the front in the next century the new Prussian monarchy was perhaps the most conspicuous. Frederick William I devoted all his energies to the creation of a strong military force, and his army of 80,000 was increased by Frederick II to 200,000. The latter introduced the system which still prevails in Prussia, and is now extended to the whole German empire, of localizing the different sections of his army. Each regiment was assigned to a certain district, which was bound to keep it at its full complement. Where voluntary enlistment did not suffice for this purpose resort was had to conscription; but this was applied only to the lowest classes of the community. The systems of drill now followed in all European armies are founded on that introduced into the Prussian army by Leopold of Dessau, who organized it under Frederick William I. Cavalry tactics were greatly improved by Frederick the Great himself, who also was the first to use horse artillery. The dividing of artillery into batteries is of about the same date, but is due to a Frenchman named Gribeauval.

Since the time of Frederick the Great a great change has taken place in the composition of armies through the reintroduction of the principle of the universal liability of all men capable of bearing arms to military service, or, in other words, through the raising of armies by a general conscription, now practised in every European country. Conscription was first adopted by France in 1798, and it was by means of it that Napoleon was able to raise the large armies with which he overran and conquered a great part of the Continent. In 1808 it was adopted by Prussia, by which power it has been applied with greater rigor than by any other. In Prussia it was combined with the short-service system, a mode of training the population to arms suggested by Napoleon's attempt in the Peace of Tilsit to limit the Prussian army to a certain strength. This system consists in requiring those serving in the active army to remain under arms for a comparatively short term (in Prussia three years), during which they become thoroughly trained soldiers ready for active service on any emergency. Every year a certain number return from the army to civil life, and are replaced by others who are subjected to military training for the same term. By this means Prussia, while never maintaining a larger active army than that prescribed by the Peace of Tilsit, was able to train its whole able-bodied male population to arms, and that without allowing the fact to be discovered until it was made manifest by the war of revenge in 1813. In other countries where the principle of conscription had been adopted its operation was greatly weakened by the numerous exemptions that might be obtained, and especially by allowing those required to serve to obtain exemption by paying for a substitute. Especially was this the case in France, where, under Napoleon III, the army had again become to all intents and purposes a professional one. In army organization the principal change that has been made since the introduction of conscription has been the establishment of army corps (*corps d'armée*), that is, divisions of an army composed of all arms (infantry, cavalry and artillery), and placed under the command of a single general. These divisions were first established by Napoleon, who placed them under the command of his marshals. The division was afterward adopted by Prussia and extended to the German empire, where the further improvement is made of localizing each army corps in a certain province or member of the empire, in which it is reunited, and in which are kept all the arms and other equipments necessary for its mobilization. In the Prussian army the cavalry are very numerous, and are used principally on the march, when they are sent in front to cover the advance of the main body of the troops, and to collect information. In all armies considerable changes in tactics have resulted from the increased range, precision and rapidity of fire of the improved artillery and musketry now in use.

In most nations, will now be found an army of reserve, intended to augment the standing army from a peace to a war strength, and consisting of two classes — those waiting an immediate call to arms, if required, and those constituting the militia — the entire effective military power of the state. It may be of interest here to mention certain distinctions in the application of the word army. A covering army is encamped for the protection of the different passes or roads which lead to the town or other place to be protected. A siege army is ranged around or in front of a fortified place, to capture it by a regular process of besieging. A blockading army, either independent of, or auxiliary to, a siege army, is intended to prevent all ingress and egress at the streets or gates of a besieged place. An army of observation takes up an advanced position, and by celerity of movement keeps a close watch on all the manœuvres of the enemy. An army of reconnaissance has a

more special duty at a particular time and place, to ascertain the strength and position of the enemy's forces. A flying column is a small army carrying all its supplies with it, so as to be able to operate quickly and in any direction, independently of its original base of operations.

EDWARD S. FARROW,
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ARMY ADMINISTRATION. The administrative branch of the government, known as the War Department, and presided over by the Secretary of War, is second to none in real importance. Much of the business carried on by the Secretary of War has little or no connection with the military arm of the government, but by a process of accumulation of statutes and authorities, resulting often from the expediency of the moment, the present vast dimensions have been reached. The methods of conduct of business remain practically the same to-day as in the War of 1812, except that through a long course of years, there has grown up a system of laws and regulations fixing in great detail the complex duties of the various bureaus.

Ordinarily army administration consists in the organization and other means by which various administrative duties are performed, necessary to provide for the wants of troops, and for all the foreseen demands of a state of war, including labor and the supplies for garrisons, sieges, etc. Such duties embrace subsistence-magazines, daily rations, forage, dress, encampments, barracks, hospitals, transportation, etc., the administrative duties of engineers and of the ordnance department, estimates, accountability, payments, recruiting and in general the receipt and proper application of money. The Secretary of War, under the orders of the President, is the head of military administration in the United States. The object of such administration is to provide, through the resources placed by law at his disposition, for the constant wants, regular or accidental, of all who compose the army. Good administration embraces a foreknowledge of wants, as well as the creation, operation and watchfulness of the ways and means necessary to satisfy them; the payment of expenses, and the settlement of accounts. Army administration is divided into several branches determined by law. These different branches constitute the administrative service of an army, the operations of which should be so regulated that the Secretary of War will be always informed of the condition of each, and be able to exercise, subordinate to law, a complete financial control over each. The Adjutant-General of the army and the heads of the administrative corps have each been assigned a bureau in the War Department, under the direction of the Secretary of War, for the management of the administrative duties with which they have been respectively charged. Administration and Command are distinct. Administration is controlled by the head of an executive department of the government, under the orders of the President, by means of legally-appointed administrative agents, with or without rank; while Command, or the discipline, military control and direction of military service of officers and soldiers, can be legally exercised only by the military hierarchy, at the head of which is the constitutional commander-in-chief of the army, navy and militia, followed by the commander of the army, and other military grades.

ARMY AVIATORS. See MILITARY AERONAUTICS.

ARMY BOUNTY. See BOUNTY.

ARMY COMMISSARY. The duties of an army or corps commissary, like those of division, brigade or regimental commissaries, are to see that all troops with or in his particular command are properly supplied with good and wholesome food; these duties for an army are, of course, on a more extended scale than for a regiment, but in general principles, forms, manner of procuring and issuing stores, in nearly all cases, the same rules will apply to the one as to the other.

The requisitions of an army commissary should always be approved by the commanding officer of the army; he should know accurately the number of troops in the command, and their different posts or stations. If the command is an extended one, there being many detached posts, he should at once ascertain the different methods of access to them, the probability of continuous or interrupted transportation, and endeavor to keep each post supplied in such a manner as to guard against any contingency arising from a lack of transportation. He should know the amount of stores on hand at any time, and the amount of stores due on any requisition. In order to facilitate his work, he should call upon all subordinate officers, particularly upon those having charge of stores in bulk, to make frequent reports (trimonthly are usually sufficient) showing the amount of stores on hand at each depot or post suitable for issue or for sale to officers. Should any stores at the different posts become damaged, or unfit for issue, he should require that they be immediately reported to him, in order that he may make the necessary arrangements for replacing them. In an extended command he should make, or if his duties will not permit of his attending to it personally, he should have at least one practical commissary to act as an inspector, who should make frequent inspections of the stores at every post, examining the stores, their condition, quantity, quality, and, above all, the manner of caring for and protecting them.

The more stores are handled from the time they leave the depot until their final distribution to the different companies of the regiment for which they were drawn, the greater is the damage and wastage, and when possible for the division commissary to draw in bulk, and issue at once on the proper returns, the damage is slight and the wastage, if any, is easily accounted for by the one officer; but if he again transfers to a brigade commissary, who, in turn, transfers to a regimental commissary, the same wastage occurs in the second and third transfer, and subsequent issues, as would occur in the first, while the proportion would be greatly reduced if but one officer had the entire charge of the issue.

ARMY CORPS. When an army is very large, three or four divisions are joined together and form an "Army Corps." The officer commanding an army corps should be of a higher grade than he who commands a division.

This grade, in the United States Army, is that of major-general. An army corps is most generally composed of all arms of service, and is, to all intents and purposes, an army complete in itself. Two or more army corps, or armies, would be under the command of the general, or of a general-in-chief. The functions of general officers are to command armies, or fractions of an army greater than a regiment, when mobilized. In time of peace, when the regiments are not formed into brigades or divisions, but are distributed over districts of country, the function of the general is to command the troops in these districts, which are then designated by the term "military departments."

ARMY DISPENSARIES. Medical officers and contract surgeons on duty attend officers, enlisted men, contract surgeons, acting dental surgeons, members of the nurse corps, prisoners of war, and other persons in military custody or confinement, and applicants for enlistment while held under observation; also, when practicable, the families of officers and enlisted men; and at stations, or in the field, where other medical attendance cannot be procured, civilian employees. Medicines are dispensed to all persons entitled to medical attendance, and hospital stores to enlisted men and hospital matrons, also to officers at posts or stations where they cannot be procured by purchase. Medical officers and contract surgeons at their stations furnish medical attendance to officers and enlisted men on the retired list, but they are not required to leave their stations for that purpose. Medicines, dressings, etc., are supplied to retired officers and enlisted men from army dispensaries on medical officers' prescriptions.

ARMY FIELD ENGINEERS SCHOOL. See ARMY SCHOOLS.

ARMY FIELD SERVICE SCHOOL FOR MEDICAL OFFICERS. See ARMY SCHOOLS.

ARMY MEDICAL BOARD. A board of at least three officers, appointed by the Secretary of War, which passes on the appointment and promotion of officers in the Medical Corps of the United States army. The preliminary examinations for commissions in the Medical Corps may also be given by other designated boards.

ARMY MEDICAL SCHOOL. A school located in Washington, D. C. Its personnel consists of the faculty, such special professors and instructors as may be assigned to temporary duty at the school, the students and such enlisted men and civilian employees as are assigned to it for duty. Its object is to train the students therein in the subjects that pertain to the duties of the medical department. It also carries on such scientific work and investigations as are directed or authorized by proper authority. The commandant, professors and assistant professors are detailed by the War Department from among the officers of the medical corps; the special professors are nominated by the faculty, with the approval of the surgeon-general, from among distinguished members of the medical reserve corps; the instructors are officers of other branches of the army detailed by the War Department to give special courses of instruction. The faculty consists of the commandant who is its president, the professors and assistant professors. It meets at such times as the commandant deems advisable. It arranges the program of instruction, prescribes the textbooks appropriate thereto, the allotment of time to each subject, and the character and scope of the examinations, and has final determination of all questions concerning the proficiency of students, subject, however, in all respects to the express provisions of law. The adjutant is the secretary of the faculty and is chosen by the commandant from among the professors or assistant professors. He is the custodian of the records of the faculty, conducts the correspondence of the school and promulgates the orders of the commandant.

The student-body consists of officers of the medical reserve corps who are candidates for appointment in the medical corps, such medical officers of the army and of the organized militia as may be ordered or authorized to attend the school, and enlisted men of the hospital corps ordered to the school for instruction. The army field service and correspondence school for medical officers is a branch of the army service schools at Fort Leavenworth and is governed by regulations published in general orders.

ARMY AND NAVY BOUNTIES. See BOUNTIES.

ARMY AND NAVY GENERAL HOSPITAL. This hospital located at Hot Springs, Ark., is under the direction of the Secretary of War, and is devoted to the treatment of the officers and enlisted men of the military and naval service of the United States, cadets at the United States military and naval academies, officers of the Revenue-Cutter service, officers of the Public Health service and honorably discharged soldiers and sailors of the regular and volunteer army and navy of the United States, for such diseases as the waters of the Hot Springs of Arkansas have an established reputation in benefiting. Admission to this hospital is restricted to those of the above-named classes who require medical treatment in the following order of preference: (1) Officers and enlisted men of the army, the navy, and the marine corps on the active lists, and cadets at the United States military and naval academies; (2) Officers and enlisted men of the army, the navy and the marine corps on the retired lists; (3) Officers of the Revenue-Cutter service and of the Public Health service; (4) Honorably discharged soldiers and sailors of the regular and volunteer army and navy of the United States may also be admitted by authority of the surgeon-general when there are vacant beds in the hospital.

ARMY AND NAVY MANŒUVRES. The object of manœuvres is to train, in time of peace, the fighting forces of a nation by handling them, as far as practicable, as in time of war, the forces designated being divided for this purpose into two opposing bodies. Previous military training is presupposed. Manœuvres are of three kinds: First, Land manœuvres, taking place entirely on land; second, Naval manœuvres, where fleets manœuvre against

fleets; third, Combined army and navy manœuvres. The last two are of comparatively recent origin. Manœuvres are now annually held in all the principal countries of Europe. They are the culmination and test of the military instruction of the year. As operations in the grand manœuvres are carried on over a large extent of territory, the time fixed is after the crops are harvested so that agricultural interests are interfered with as little as possible. The annual manœuvres begin with regimental and brigade exercises for the infantry, with battalion exercises for field artillery (a battalion consists of two or more batteries) and with special manœuvres for cavalry. Manœuvres are also carried on all over the country by the army corps not participating in the grand manœuvres. The program for the grand manœuvres is carefully worked out beforehand by the general staff.

These manœuvres are of great value in training officers, especially staff officers. They also serve as a sort of examination for officers, whose work in the field comes under the observation of their superiors. Officers showing zeal and ability are marked for advancement, while those whose work does not come up to the standard are reproved or even more severely dealt with. In the United States circumstances have prevented the carrying on of army manœuvres except on a small scale, the American army being so widely scattered that a large enough force to make it worth while could not be brought together without great inconvenience and expense.

Naval Manœuvres may be tactical or strategical; the former having to do with the handling of fleets when they are within sight of each other, the latter when they are not. As all the elements, such as size and speed, character and arrangement of armor, number and power of guns, of different classes of ships, battleships, cruisers and torpedo boats, are well known, it is supposed, when they come in conflict, that the result will be a foregone conclusion, assuming the personnel to be of equal quality. The personal element, the man behind the gun, while of vital importance in war, is a factor that cannot be easily estimated in tactical manœuvres. Much more attention is therefore given to strategical manœuvres. A fleet going out for manœuvres is divided into two squadrons, one to attack, the other to defend. A passive defense is not contemplated. While the object may be the defense of a harbor, the way to accomplish it is not to wait in port for the enemy, but to go out to seek him on the open sea. Otherwise the advantage of one of the most valuable characteristics of ships, their mobility, would be lost. In the United States combined army and navy manœuvres were inaugurated in 1902. The decision as to whether the fleet or the land forces win is of minor importance. The manœuvres are of great value to both the army and navy. For the former they give instruction in the most efficient means of coast defense, including the co-ordination of all its various elements; the best system of fire control; the best location and employment of search-lights and range-finders; the best means of obtaining and transmitting information. They serve to point out any defects in the location and plans of the fortifications, and whether the number, type and mounting of guns are the best adapted for the purpose at any particular site. For the navy they afford a test of the means of obtaining the ranges of the forts and batteries, and of conveying the information to the officers in charge of the guns. They give information as to the effect of mines and obstructions in impeding the movements of ships and the methods to be used in forcing such a passage or in removing the obstructions. They give instruction as to the best manner of approach and of manœuvring under fire, the formations to be used, the speed and the distance between ships; the method of attacking by night or in a fog; the use of the search-light for lighting the target or blinding the eyes of the enemy's gunners or range-finders. The manœuvres rouse the interest and stimulate the *esprit de corps* of the personnel of both services and teach it to make the best use of war material under conditions as nearly as possible like those of actual war.

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ARMY AND NAVY UNION. An organization composed exclusively of men who have served in some branch of the army or navy of the United States. Its objects are "to bring together and unite in benevolent and social fellowship those who have served their country honorably; to provide for the sick and distressed; to assist in the burial of the dead, and to extend a helping hand to the family of a deceased comrade or shipmate."

ARMY NURSE CORPS. The superintendent of the nurse corps, under the direction of the surgeon-general, has general supervision of the corps, and her duties and the duties of chief nurses and nurses are as prescribed by the surgeon-general. The services of army nurses are afforded sick and wounded officers, enlisted men, and other patients in military hospitals. When traveling under orders on transports they assist in the care of sick officers and enlisted men, under the direction of the transport surgeon. Members of officers' and enlisted men's families are not entitled to the services of army nurses, but in great emergencies and for the manifest interest of the service, nurses will care for such patients when so directed by the officer in charge of the hospital, a report of the fact being made in each instance to the surgeon-general through military channels. At places where the services of trained nurses are not otherwise obtainable, a nurse may, if she so desires, and with the approval of the officer in charge of the hospital, be granted a special leave, without pay and allowances, in order to take a private case, such leaves not to exceed 60 days. The pay, allowances, and privileges of nurses are specified by law, and they are forbidden to receive presents from patients, or from the relatives or friends of patients, for services rendered when on duty.

See UNITED STATES, ARMY OF.

ARMY OF THE UNITED STATES.—ARMY ORGANIZATION. United States.— The land forces of the United States are classified into the Regular Army, in which enlistment is for four years with the colors and

three in the unorganized Army Reserve, the Officers Reserve Corps, and the Enlisted Reserve Corps, forces called or drafted into the service of the United States, the Organized Militia of the several States, and the unorganized militia, consisting of all males between 18 and 45 who are fit to bear arms and are citizens of the United States, or have declared their intention to become citizens. The President of the United States is the Commander-in-chief of the United States Army by right of office, and he nominates for the approval of Congress such general officers of the rank of general or lieutenant-general as he deems necessary properly to officer the higher commands. The administration is carried on by the War Department under the direction of the Secretary of War, who is a member of the official cabinet of the President. For administrative purposes the following divisions are made: The *General Staff Corps* prepares all plans for national defense, for mobilization of the forces, and has a general supervision of all questions affecting the efficiency of the Army, and is under the charge of the chief of staff. The *Adjutant-General's Department* keeps all records and has charge of all correspondence, the issuing of orders, notices, bulletins and official literature, and is under the charge of the Adjutant-General. The *Inspector-General's Department* exercises general supervision over all matters that have to do with the efficiency of the Army — the conduct and discipline, condition of uniforms, equipments, supplies and expenditure of public money, and is under the charge of the Inspector-General. The *Judge-Advocate's Department* is the custodian of all legal records, has a general supervision over all courts-martial, courts of inquiry and military commissions, and is under the charge of the Judge-Advocate-General. The *Ordnance Department* supplies all arms, equipments and other fighting material and maintains the arsenal and depots for the manufacture, distribution and safe-keeping of military stores, and is under the charge of the Chief of Ordnance. The *Quartermaster Corps* takes care of all matters of supply (other than ordnance), transportation, distribution of funds and payment of troops, and is under the charge of the Quartermaster-General. The *Engineer Corps* is in charge of the construction and maintenance of all fortifications, military posts, lines of communication and rivers and harbors, as far as is necessary for their use for military or naval purposes, and is under the charge of the Chief of Engineers. The *Coast Artillery Corps* is in charge of the garrisoning of all coast fortifications and coast and harbor defense and siege work, and is commanded by the Chief of Coast Artillery. The *Signal Corps* is in charge of all methods of communication by balloons, aeroplanes, wireless telegraphy, telephones and visual signaling, and is commanded by the Chief Signal Officer. The *Medical Department* is subdivided into (a) the Medical Corps, which is in charge of the sick and wounded and the physical and sanitary condition of the army, detachments of which are known as sanitary troops when serving with other troops; (b) the Dental Corps, which is in charge of the teeth; (c) the Medical Reserve Corps, which secures a reserve of medical officers available for military service; (d) the Hospital Corps, which renders all necessary hospital services in garrison, camp or field (including the ambulance service); (e) the Nurse Corps, from which nurses may be assigned to active duty when the emergency of the service demands. The Surgeon-General is in charge of the Medical Department and all its branches. The *Bureau of Insular Affairs* is in charge of all matters of a military nature and of the supplies that affect the colonies, and is under the control of the Chief of Insular Affairs. The *Bureau of Militia Affairs* is in charge of the affairs of the National Guard and is under the direction of the Chief of Militia Affairs.

The organization of the fighting forces of the United States in May 1917, was based on following units: A *Squad* consisting of 1 corporal, as squad commander, and 7 privates, or privates, first class: a *Platoon* consisting of 1 first lieutenant, second lieutenant or sergeant, as platoon commander, and 4 squads. The organization of the United States Army at the present time (1917) is in a state of change. Besides the scheme outlined in the "Tables of Organization" on 3 May, a new organization for overseas service was outlined in the *Official Bulletin* for 22 September. The following table is an outline of the comparative structure of the two systems (the numbers stand for officers and men combined):

In an infantry division there are

SCHEME OF 3 MAY 1917 (Maximum strength)	SCHEME OF 22 SEPTEMBER 1917
1 division headquarters under a major-general (153)	1 division headquarters under a major-general (164)
	1 machine-gun battalion of four companies (768)
3 infantry brigades (18,579)	2 infantry brigades (16,420)
1 field-artillery brigade (4,030)	1 field-artillery brigade (5,068)
1 cavalry regiment (1,579)	
1 field signal battalion (259)	1 field signal battalion (262)
1 regiment of engineers (1,098)	1 regiment of engineers (1,666)
1 train headquarters and military police (332)	1 train headquarters and military police (337)
1 ammunition train (702)	1 ammunition train (962)
1 supply train (332)	1 supply train (472)
1 engineer train (170)	1 engineer train (84)
1 sanitary train (927)	1 sanitary train (4 field hospital companies and 4 ambulance companies (949)
1 aero squadron (173)	
Total, 28,334	Total, 27,152

In an infantry brigade there are

1 headquarters (19)	1 headquarters (about 140)
3 infantry regiments (6,060)	2 infantry regiments (7,510)
	1 machine-gun battalion of three companies (560)
Total, 6,079	Total, 8,210

In a field artillery brigade there are

1 headquarters (19)	1 headquarters
2 regiments of 3-inch field guns (2,687)	3 regiments of 75 mm. field guns ( )
1 regiment of 3 8-inch howitzers (1,337)	1 trench-mortar battery ( )
Total, 3,943	Total, 5,068

An infantry regiment contains

1 headquarters and headquarters company (61)	1 headquarters and headquarters company (303)
3 battalions of four line companies each (1,842)	3 battalions of four line companies each (3,078)
1 supply company (39)	1 supply company (140)
1 machine gun company (78)	1 machine gun company (178)
1 medical detachment (38)	1 medical detachment (56)
Total, 2,958	Total, 3,755

An ordinary infantry company contains

1 captain, 1 first lieutenant, 1 second lieutenant, 1 first sergeant, 1 mess sergeant, 1 supply sergeant, 8 sergeants, 17 corporals, 2 mechanics, 3 cooks, 2 buglers, 28 privates (first class), 87 privates. Total, 3 officers, 150 men.	1 headquarters (2 officers, 18 men), 4 platoons, each including 1 headquarters (1 officer, 1 man), 2 sections riflemen (24 men), 1 section bombers and rifle grenadiers (22 men), 1 section auto riflemen (11 men, 4 guns). Total, 6 officers, 250 men.

An infantry supply company contains

1 captain (chief supply officer), 1 second lieutenant as assistant, 3 regimental supply sergeants, 1 first sergeant, 1 mess sergeant, 1 stable sergeant, 1 corporal, 1 horseshoer, 1 saddler, 27 wagoners and 1 cook. Total, 39.	(Composition not officially published).

Total, 140

A machine-gun company contains

1 captain, 1 first lieutenant, 2 second lieutenants, 1 first sergeant, 1 supply sergeant, 1 mess sergeant, 1 stable sergeant, 7 sergeants, 8 corporals, 1 horseshoer, 2 mechanics, 2 cooks, 2 buglers, 12 privates (first class), 36 privates. Total, 4 officers, 74 men, 6 guns.	1 headquarters (3 officers and 21 men), 3 platoons (each containing one officer and 46 men), a train of 13 men, armament, 12 heavy machine guns and four spare guns. Total, 6 officers, 172 men, 16 guns.

An infantry headquarters company contains

1 captain (regimental adjutant), 1 regimental sergeant-major, 3 regimental supply sergeants, 1 first sergeant, 1 mess sergeant, 1 supply sergeant, 1 stable sergeant, 1 sergeant, 1 horseshoer, 2 cooks, 4 privates (first class), 12 privates, 28 men in band. Total, 1 officer, 56 men.	1 headquarters platoon (93 officers and men), including 1 staff section (36 officers and men), 1 orderlies' section (29), 1 band section (28 men), 1 signal platoon (77 officers and men), including 1 telephone section (51 men), 1 section with headquarters (10 men), 1 section with 3 battalions (16 officers and men), 1 sappers' and bombers' platoon, including 1 section sappers (9) for digging and special work, one section bombers (34 officers and men), 1 pioneer platoon (55 officers and men), 1 one-pounder cannon platoon (33 officers and men). Total, 7 officers, 294 men.

In addition to the units already described, the establishment of 3 May contains the following organizations: A *troop of cavalry* is organized as an infantry company with the addition of a stable sergeant, 2 horseshoers, and 7 saddlers, and with only 5 sergeants, 8 corporals, 2 cooks, 20 privates, first class, and 61 privates. A *supply troop of cavalry* is as prescribed for an infantry supply company with an extra second lieutenant and an extra corporal, an extra horseshoer, an extra saddler, an extra cook and 10 extra wagoners. A *coast artillery company* is as prescribed for a line company of infantry, except that certain enlisted men, according to their duties, are rated as follows: casemate electricians, observers first class, observers second class, plotters, chief planters, coxswains, chief loaders, gun commanders and gun pointers. A *field artillery battery* of 4 guns (3 in.) is organized as prescribed for a line company of infantry, there being in addition an extra first lieutenant, an extra second lieutenant, an extra sergeant, 3 extra corporals, a chief mechanic and an extra mechanic, 3 horseshoers, an extra bugler, 7 extra privates, first class, and 21 extra privates, the privates being sometimes called drivers and cannoneers. A *pioneer company of engineers* is as prescribed for a line company of infantry, except for an extra first lieutenant and 3 sergeants, first class. Mounted companies are organized as cavalry troops with an extra first lieutenant and 2 sergeants, first class. A *pontoon company of engineers* is as prescribed for a line company of infantry, having in addition 2 saddlers in charge of harness and equipment, 2 farriers in charge of wagons. A *signal corps radio company* consisting of 1 captain as commanding officer, 2 first lieutenants, 1 master electricians, 6 sergeants, first class, 9 sergeants, 15 corporals, 2 cooks, 1 horseshoer, 35 privates, first class, and 6 privates. A *signal corps wire company* consists of 1 captain as commanding officer, 2 first lieutenants, 1 master electrician, 5 sergeants, first class, 7 sergeants, 12 corporals, 2 cooks, 1 horseshoer, 39 privates, first class, and 8 privates. A *signal corps outpost company* consists of 1 captain as commanding officer, 4 first lieutenants, 1 master electrician, 3 sergeants, first class, 15 sergeants, 14 corporals, 2 cooks, 1 horseshoer, 37 privates, first class, and 12 privates. A *company of military police* is as prescribed for a company of infantry, with 4 less privates, first class, and 2 less privates. An *ambulance company* consists of 1 surgeon with the rank of captain as commanding officer, 4 assistant surgeons with rank of captain or first lieutenant, 2 sergeants, first class, 11 sergeants, 6 corporals, 1 mechanic, 3 cooks, 96 privates in a motor-driven company, 124 in an animal-driven company, and in addition to a horseshoer, a saddler and a farrier. An *ammunition train section* (wagon transportation) consists of 1 captain or first lieutenant as commanding officer, 1 sergeant (wagonmaster), 1 clerk, 2 sergeants (assistant wagonmasters), 1 mess sergeant, 4 sergeant horseshoers, 2 sergeant farriers, 2 sergeant saddlers, 1 sergeant mechanic, 1 sergeant agent, 4 corporals (assistant wagonmasters), 1 corporal agent, 2 cooks, 60 privates, first class (teamsters and orderly), and 12 privates (laborers). An *ammunition train section* (motor transportation) consists of 1 first lieutenant as commanding officer, 1 sergeant (truckmaster), 1 clerk, 3 sergeants (assistant truckmasters), 1 mess sergeant, 1 sergeant mechanic, 1 sergeant agent, 1 corporal agent, 2 cooks, 33 privates, first class (chauffeurs), 2 privates, first class (assistant mechanics), and 9 privates as assistant chauffeurs. A *field bakery* consists of 1 captain or lieutenant as commanding officer, 60 men, rated as cooks, and 12 bake ovens. A *battalion of infantry* consists of 1 major as battalion commander, 1 headquarters and 4 line companies. A *squadron of cavalry* corresponds to a battalion of infantry and contains 4 line troops. A *battalion of field artillery*, as prescribed, contains 1 major, 1 headquarters and 3 batteries. A *battalion of engineers* is constituted as prescribed for a battalion of infantry and contains 3 companies. A *battalion of signal corps* (field battalion) consists of 1 major as commanding officer, 1 headquarters, 1 supply section of a supply sergeant and 5 men, 1 wire company, 1 radio company and 1 outpost company. A *battalion of signal corps* (aero squadron) consists of 1 major as commanding officer, 1 headquarters section under the adjutant, containing 10 men, 1 supply section with 2 officers and 37 men, 1 engineering sec-

tion with 2 officers and 19 men, 12 aero squadrons, each containing 1 captain or first lieutenant, 1 sergeant, first class, as mechanician, 2 sergeants or corporals as mechanicians, 2 privates, first class, and 2 privates. There are attached to the squadron 1 surgeon and 4 enlisted men, medical department. For a *regiment of infantry* see the tables of the old and new establishments. A *regiment of cavalry* consists of headquarters, 3 squadrons of cavalry, a headquarters troop, a machine-gun troop and a supply troop. A *machine-gun troop* — the cavalry equivalent of a machine-gun company — contains 1 more sergeant, 1 more private, first class, and 13 more privates than its analogue. A *regiment of field artillery* contains a headquarters, 2 or 3 battalions of field artillery, a headquarters company and a supply company. A *regiment of engineers* is as prescribed for infantry without the machine-gun company and with only 2 battalions. A *regimental detachment of the medical corps* consists of 1 surgeon with the rank of major, 2 or 3 assistant surgeons with the rank of captain or first lieutenant, 2 veterinarians in mounted regiments, 1 sergeant, first class, 2 or 3 sergeants, 17–29 privates, and privates first class. A *brigade* consists of 1 brigadier-general as brigade commander and his headquarters and of 2 or 3 regiments of one arm. For the constitution of an *infantry division* see the tables of the old and new establishments. A cavalry division consists of headquarters, train headquarters and military police, much like those of an infantry division, together with 3 brigades of cavalry, 1 regiment of horse artillery, 1 mounted battalion of engineers, 1 mounted battalion of signal corps, 1 aero squadron, 1 ammunition train, 1 sanitary train and 1 supply train. A *field army*, the equivalent of the army corps of foreign countries, consists of 1 lieutenant-general or major-general as commander, the following officers, whose duties are the same as the departments and corps they represent — 1 brigadier-general (chief of staff), 1 colonel (adjutant), 1 colonel (inspector), 1 colonel (judge-advocate), 1 colonel (chief quartermaster), 1 colonel (chief of engineers), 1 colonel (chief surgeon), 1 lieutenant-colonel (assistant chief surgeon), 1 lieutenant-colonel (chief of ordnance), 1 lieutenant-colonel (chief signal officer), 3 lieutenant-colonels (aides-de-camp), 2 or more divisions with additional so-called field army troops, including such troops as regiments of heavy artillery, and pontoon battalions of engineers. An army consists of such number of field armies as may be required.

The organization of the coast artillery is territorial and not by battalions or regiments. A coast artillery battery is manned by a company. Battery commands are organized into fire commands or mine commands under the charge of a major. These, together with such troops of the mobile army as may be used for purposes of support, are grouped into fort commands under majors or lieutenant-colonels. Several fort commands make a coast defense command under colonels. These again are grouped into coast artillery districts. As the coast artillery is a highly technical service, a large number of commissioned and non-commissioned staff officers are required at every stage of organization.

Foreign Countries.— The general features of army organization are much the same throughout the world and conform very closely to the scheme adopted by the United States on 22 September 1917. The range of variation is fairly indicated by the two schemes of this table. In particular, the size of an infantry company is usually from 200 to 250 men, and that of a battalion in the neighborhood of 1,000 men. The nomenclature and administration of cavalry units in the United States army is not reproduced exactly elsewhere; the usual arrangement is by squadrons of about 150 sabres, corresponding to infantry companies and grouped into regiments of four or five squadrons. The troop in the British army corresponds to a platoon and is led by a subaltern. Artillery administration is also very variable; batteries of field artillery, however, usually consist, as in the United States, of four guns. The organization known in America as a battalion of field artillery is known abroad variously as an *Abteilung*, group, brigade, or division. The organization of the technical troops, such as the engineers, train and signal corps men, is different in each army. In general, the aviators are recognized as a separate arm and are not subordinated to the Signal Corps. The army police is usually a separate organization and not, as until recently in our army, made up by details from other troops. In the British army it contains no privates — every man ranks at least as lance-corporal. In most Continental nations part or the whole of the municipal police and fire departments receive a military organization and is regarded as part of the army.

England.— The military services in the British Empire comprise the Regular Army, the Army Reserve, the Special Reserve, the Territorials, the Indian Army and the Militia forces of the various colonies. The Regular Army is organized into an expeditionary force, serving in the British Isles, and a colonial force, serving in the various colonies and India. Enlistment is normally for 12 years, which is variously divided in different branches of the army between the Regular Army and the Army Reserve. At present the terms of enlistment for active service are the duration of the war, with a minimum term of three years. The Special Reserve, for all service, and the Territorial force, for service in the United Kingdom, correspond to the organized militia in the United States, and are organized into divisions in a way in general similar to that in the Regular Army. The native Indian Army is composed of native troops under British officers and is a distinct service from that part of the Regular Army which also serves in India. All colonies also maintain bodies of troops organized in a manner similar to that in the Regular Army. In Australia and New Zealand military service is compulsory.

The British infantry is not organized into regiments as administrative units and a regiment is a mere collection of battalions of various sorts, usually recruited within a specified area. The battalions are grouped directly into brigades. The whole artillery force is

known as the Royal Regiment of Artillery and is not divided into tactical regiments. Regiments as administrative and tactical organizations are found in the cavalry. The train and pay services are separate, whereas in the United States both are under the Quartermaster Corps.

France.— The military services in France comprise the Metropolitan Army, the Colonial Forces and the Territorial Army. Service in the Metropolitan Army is compulsory and that in the Colonial Forces is by voluntary enlistment. All males between the ages of 18 and 45 are liable to military service, which is divided into (a) that with the colors (3 years); (b) that in the Metropolitan Army Reserve (10 years); (c) that in the Territorial Army (5 years); and that (final service) in the Territorial Army Reserve (9 years). The Metropolitan Army is organized into the Army of the Interior and the Algerian-Tunisian Army. The Colonial Forces are partly French and partly native troops.

Germany.— There are two main divisions of the military service in Germany — (a) regular service; (b) service in the Landsturm. All males between the ages of 17 and 45 are required to perform service in one or the other of these main divisions. Men selected for the regular service serve seven years with the standing army (three with the colors and four in reserve) and then are passed into the *Landwehr*, where they continue service until their 39th year. Service from the 39th to the 45th year is in the *Landsturm*. Men who for any reason are not required to serve in the standing army are placed in the *Eratz* reserve (special reserve) for 12 years and then passed to the *Landsturm*.

Austria-Hungary.— The military service of the Austro-Hungarian empire is divided into — (a) the *Landwehr*, or National Army of Austria; (b) the *Honved*, or National Army of Hungary; (c) the *Gemeinsames Heer*, or common army of both countries; (d) the *Landsturm*, or second reserve of Austria and Hungary. All males between the ages of 19 and 42 are liable to military service, and it is decided by lot whether such service will be in a national army or in the common army. Actual service begins at the age of 21 and lasts for 12 years. Men drawing assignment to the common army serve three years with the colors and seven years in the reserve of that army. They then serve an additional two years in the reserve of a national army, and at the expiration of this service pass to the *Landsturm*. Men drawing assignment to a national army serve two years with the colors of that army and 10 years in its reserve. They then pass to the *Landsturm*.

The Austro-Hungarian army in war time is not divided into three forces as in peace, but forms one army composed of all three elements. The administrative unit is the field army, consisting of from two to four corps, and these in turn of usually three divisions. Two of these divisions are drawn from the common army and the third from the *Landwehr* or *Honved*, or from the reserves of the first line.

Italy.— Military service in Italy comprises (a) that in the standing army; (b) that in the Mobile Militia; and (c) that in the Territorial Militia. Every adult male between the ages of 20 and 39 years is liable to service in one of these branches. In time of war the army is the grand unit of organization in the Italian service. Each army is composed of three corps, one division of cavalry and auxiliary troops.

Russia.— All male Russian subjects, with the exception of the Mohammedan native Caucasian population and the population of a few provinces, are liable to military service from the 21st to the 44th year of age. This service is divided into (a) that in the standing army and reserves, and (b) that in the Imperial Militia. At the annual levy the class of service to which a man is assigned is determined by lot.

Japan.— The military service in Japan is divided into — (a) the active army (Genyeki); (b) first reserve (Yobi); (c) second reserve (Kobi); (d) replacement troops (reserve of recruitment) (Hoju); (e) the National army, first and second parts (Ko kumin-hei). Service is obligatory on all males between the ages of 17 and 40. The active army is divided into divisions and reserve divisions, each of which occupies a military district and is complete in itself, not only as regards combatant troops, but as regards auxiliary troops, including the medical department. In matters of general administration, decentralization is the keynote of the Japanese army, and each division is almost autonomous. It is maintained complete in all its branches in time of peace so that it can be moved in its entirety in time of war and its place immediately taken by a reserve division. In time of war two or more divisions (usually three) are mobilized to form field armies. See ARMY; ARTILLERY; CAVALRY; INFANTRY; RANK; TACTICS. Consult Balck, 'Tactics' (tr. Fort Leavenworth, Kan., 1914); War Department, 'Tables of Organization' (Washington 1914 and 1917).

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ARMY RATION. There are three varieties of the American army ration, garrison, field and emergency. The garrison ration is given soldiers at regularly established military posts; while the field ration is issued to troops in the field in active campaign. The emergency ration is a condensed ration, in which the best and most valuable nutritive elements are combined in the smallest bulk. In composition, the garrison and field ration are almost identical. Each ration, which is supposed to keep the soldier one day, furnishing breakfast, dinner and supper, consists of 20 ounces of fresh beef or mutton, 12 ounces of bacon, 16 ounces of canned meat or canned fish, 14 ounces of dried fish or 18 ounces of pickled fish, 18 ounces of flour or 20 ounces of corn meal, either 2 ounces of beans or peas or 1⅔ ounces of rice or hominy, and either 16 ounces of potatoes or 12⅔ ounces of potatoes together with 1⅔ ounces of dried fruit, 1⅔ ounces of coffee, and 3⅓ ounces of sugar. The ration also includes small quantities of vinegar, salt, pepper, soap and candles.

Rations are usually computed by the hundred, and are issued for ten days. To a company of 100 men, would, therefore, be issued 1,000 rations. In the field, each soldier is sup-

posed to carry one regular ration and one emergency ration all the time. The emergency ration is never eaten, except in case of last resort, and the regular ration is issued every day.

The army ration, it will be seen, contains none of those things which are ordinarily considered luxuries. For instance, there is no milk included in the ration, and the soldier must take his coffee black, unless he is able to purchase a can of condensed milk from the "sales store" with his "savings." Congress has authorized the commissary to keep on hand other articles of food that are not included in the regular ration. These are kept in the "sales stores," and are issued to the mess stewards, in return for "savings" from the regular rations. Out of a company of a hundred men there are a number who do not eat all of the articles in the ration These would be wasted if drawn by the mess steward; therefore, when the thousand rations are issued to him, he returns to the commissary that part of the various components that he thinks will not be used. This, in the language of the army, is making a "savings" on the rations.

The value of the articles returned to the commissary is computed, and the mess steward is allowed to draw from the "sales stores" a sufficient quantity of luxuries that are not in the regular issue, equal to the value of his "saving." The government, however, will not allow a "saving" to be made on certain articles in the ration. Fresh meat, dried or preserved fish, potatoes, onions, tomatoes, prunes, apples and peaches must be used; a "saving" cannot be made on these articles. They contain just the proper nutritive elements, and the quantities given are what the normal soldier should eat.

ARMY REGISTER. The official list of the United States army, published annually, showing the position, rank and duties of officers, regiments, companies, etc., with the promotions and casualties during the preceding 12 months.

ARMY REGULATIONS. The Constitution of the United States provides that "Congress shall have power to make rules for the government and *regulation* of the land and naval forces." The only acts of Congress in force, authorizing the President to make regulations better defining the powers and duties of officers, are contained in the 5th section of the act of 3 March 1913, and the 9th section of the act approved 26 April 1816. The first of these acts is an act for the better organization of the General Staff of the army, and the second relates (with the exception of the last section) to the same subject.

The words *regulate* and *regulation* are used in several places in the Constitution of the United States. Thus, Congress has power to "regulate" commerce, to "regulate" the value of money, to make rules for the government and "regulation" of the land and naval forces, to make "regulations" with regard to the elections of senators and representatives, to make "regulations" with reference to the jurisdiction of the Supreme Court, in certain cases, and to make needful rules and "regulations" respecting the territory and other property of the United States. In all these cases regulation is legislation.

By virtue of its power to make rules and regulations for the land and naval forces, Congress covers a large field of legislation relating to the administration of military affairs. When this is done there still remains a mass of matters appertaining to the military establishment, which it is necessary to "regulate." Legislation cannot enter into all the details of this regulation, and, if it could, it would not be desirable, because a legislative code controlling the whole subject of military administration would not have the necessary elasticity. The Constitution provides a way of supplementing this power of Congress, the President, as executive and commander-in-chief of the army, having the power to make regulations for its government.

The regulations for the transaction of the public duties and business relating to the military establishment, adopted by the President in the exercise of this power, are designated as the army regulations. They may be divided into several classes, viz.:

1. Those which have received the sanction of Congress. These cannot be altered, nor can exceptions to them be made by the executive authority unless the regulations themselves provide for it. In reality, the approval of Congress makes them legislative regulations, and they might, therefore, be more strictly classified with other statutory regulations with reference to subjects of military administration. They are, however, included under the general head of army regulations, as approved codes of executive regulations.

2. Those that are made pursuant to, or in execution of, a statute — meaning by the latter expression those that are supplemental to particular statutes, and, in the absence of sufficient legislative regulation, prescribe means for carrying them out. These, if it be not prohibited by the statute, may be modified by the executive authority, but until this is done they are binding as well on the authority that made them as on others. It has been held that a regulation of the Treasury Department, made in pursuance of an act of Congress, "becomes a part of the law, and of as binding force as if incorporated in the body of the act itself." So it has been held that the civil service rules, promulgated under the Civil Service Act, "became a part of the law," and that removal from a position placed under the act and the rules can only be made agreeably to the terms and provisions of both the act and the rules, and an army regulation made pursuant to a provision contained in an act of Congress is of the same force. Examples of regulations of this class are those relating to the examination of enlisted men for commissions, under the act of Congress of 30 July 1892, and the executive order of 30 March 1898, prescribing limits of punishment.

3. Those emanating from, and depending on, the constitutional authority of the President, as commander-in-chief of the army and as executive, and not made in supplement to particular statutes. These constitute the greater part of the army regulations. They are not only modified at will by the President, but exemptions from particular regulations are given in exceptional cases; the exercise of this power with reference to them being found necessary. "The authority which makes them (regulations)

can modify or suspend them as to any case, or class of cases, or generally."

4. Departmental regulations, made by virtue of the authority conferred by section 161, Revised Statutes, on the head of each department "to prescribe regulations not inconsistent with law, for the government of his department, the conduct of its officers and clerks, the distribution and performance of its business, and the custody, use, and preservation of its records, papers and property appertaining thereto."

Mere repetitions of legislative enactments are not included under any of these heads. A long continued practice has been held equivalent to a specific regulation.

As to the subject-matter of regulations for the government of the army, no distinct line can be drawn separating the President's constitutional power to make them from the constitutional power of Congress "to make rules for the government and regulation" of the land forces. Regulations are, when they relate to subjects within the constitutional jurisdiction of Congress, unquestionably of a legislative character; and if it were practicable for Congress completely to regulate the methods of military administration, it might, under the Constitution, do so. But it is entirely impracticable, and therefore it is in a great measure left to the President to do it. So far as Congress chooses to exercise its jurisdiction in this respect, it occupies the field, and the President cannot encroach on it. But when it does not see fit to do so, the President's power, of necessity, is called into action. It is, indeed, of the commonest occurrence for Congress to regulate a subject in part, and for the Executive to regulate some remaining part, and this without any pretense of statutory authority, but upon the broad basis of constitutional power. We thus have a legislative jurisdiction, and, subject to it, an executive jurisdiction extending over the same matter.

So, also, as between the legislative and judicial powers, Congress may regulate the procedure of the Federal courts, but in so far as it does not do it, the courts may prescribe their own regulations. And this is, in fact, the existing condition. Congress has exercised the power in part, leaving it to the courts to regulate what it has not provided for. Courts cannot exercise their jurisdiction without rules of procedure, and necessarily have the original power of adopting their own when the legislature does not prescribe them; just as the President cannot exercise his power as commander-in-chief without the power to make orders for the regulation of the army. In fact, each branch of government — the legislative, executive and judicial — has the original power of making regulations for the transaction of its business — most manifestly so when the business is of direct constitutional origin — but the legislative has sometimes a jurisdiction over the regulations of the other branches, and when this happens its jurisdiction is superior.

In speaking of the powers of Congress over the administration of the affairs of the army, it is, of course, not intended to include what would properly come under the head of the direction of military movements. This belongs to command, and neither the power of Congress to raise and support armies, nor the power to make rules for the government and regulation of the land and naval forces, nor the power to declare war, gives it the command of the army. Here the constitutional power of the President as commander-in-chief is exclusive.

When Congress fails to make regulations with reference to a matter of military administration, but either expressly or silently leaves it to the President to do so, it does not delegate its own legislative power to him, because that would be unconstitutional, but expressly or silently gives him the opportunity to call his executive power into play. It is, perhaps, not easy to explain why, if regulations may, under the Constitution, be made both by the legislative and executive branches, one should have precedence over the other; but it is to be noticed that the power of Congress is the express one "to make rules for the government and regulation of the land and naval forces," whereas the power of the President is a *construction* of his position as executive and commander-in-chief. The legislative power, by the words quoted, covers the whole field of military administration, but it is not always certain how far the executive power may go. It is not as well defined as the legislative power, but it is undoubtedly limited to so much of the subject as is not already controlled by the latter. The jurisdiction of the executive power is not, however, within this limit, coextensive with that of the legislative power, because the legislative branch of the government has a constitutional field of operation peculiar to itself, and yet there are army regulations which seem to be of a legislative character. It is because of this that difficulty sometimes occurs, a difficulty which has in the past quite often taken the form of a difference of views between the War Department and the accounting officers of the Treasury.

An impression has existed that a peculiar "force of law" is given to regulations by their approval by Congress, but it seems to be an erroneous one. If, as above stated, the making of regulations is within the jurisdiction both of Congress and the President, but the authority of Congress is superior to that of the President, it follows that when regulations are approved by Congress they cannot be altered by him until the approval is removed. To this extent, regulations approved by Congress may be said to have a superior force of law to those not thus approved, but this is not the erroneous impression referred to. Precisely what it is, is not clear, but it seems to have been believed that the approval of regulations by Congress makes them of higher obligation. This, however, is not true. Whether approved by Congress or not, they have, so long and so far as they are in force, the force of law, and are, therefore, binding. The distinction, in this respect that has sometimes been made between regulations approved by Congress and those not thus approved is misleading. Congress has, on several occasions, given its sanction to army regulations:

1. An Act of 3 March 1813, provided, "That it shall be the duty of the Secretary of the War Department, and he is hereby authorized, to prepare general regulations, better defining and prescribing the respective duties and powers of the several officers in the adjutant-general, inspector-general, quartermaster-general and

commissary or ordnance departments, of the topographical engineers, of the aids of generals, and generally of the general and regimental staff; which regulations, when approved by the President of the United States, shall be respected and obeyed, until altered or revoked by the same authority. And the said general regulations, thus prepared and approved, shall be laid before Congress at their next session."

A system of regulations was laid before Congress as required by the act. It was published (together with the statutes relating to the military establishment) in book form, from the adjutant and inspector-general's office, 1 May 1813, and may also be found in volume I of the 'American State Papers on Military Affairs.'

2. By Act of 24 April 1816, it was prescribed "that the regulations in force before the reduction of the army be recognized, as far as the same shall be found applicable to the service, subject, however, to such alterations as the Secretary of War may adopt, with the approbation of the President." The reduction referred to was made in June 1815, pursuant to an Act of 3 March. The Act of 24 April 1816, did not relate to any particular code of army regulations, but to all the regulations which were in force.

3. On 22 Dec. 1819, the House of Representatives resolved that "the Secretary of War be instructed to cause to be prepared and laid before this House, at the next session of Congress, a system of martial law, and a system of field service and police, for the government of the Army of the United States."

On 22 Dec. 1820, the Secretary of War accordingly submitted a system of "martial law," prepared by Judge-Advocate Major Storrow (which was never adopted), and a system of field service and police, which had been prepared by General Scott, and submitted to the War Department in September 1818.

On 26 Dec. 1820, the Speaker laid them before the House. The document was in manuscript, and was ordered to be printed, and a copy laid upon the desk of each member. (It is reprinted in the third volume of the State Papers on Military Affairs.) When the book was printed, several copies were sent to General Scott, who made certain corrections, and on 20 Feb. 1821, returned a copy (of which he retained a duplicate) to the War Department for the Committee of the House. It was received by the chairman of the Military Committee on 23 Feb. 1821.

On 27 Feb. 1821, the chairman of the Military Committee of the House reported the Senate bill, "To reduce and fix the military peace establishment," with certain amendments, among which was the addition of a section approving and adopting "the system of General Regulations for the Army, compiled by Major-General Scott." The bill, including this (the 14th) section, became law 2 March 1821. Early in that month, General Scott received directions to put the book to press for the use of the army, and, having received a letter from the chairman of the Military Committee of the House, informing him that the corrected copy had been received, and section 14 added to the army bill by way of amendment, he caused the book to be reprinted from his retained duplicate corrected copy.

4. By an Act of Congress of 28 July 1866, the Secretary of War was directed to have prepared, and to report to Congress, at its next session, a code of regulations for the government of the army and of the militia in actual service, including rules for the government of courts-martial, the existing regulations (those of 1863) to remain in force until Congress should have acted on such report.

It was said by the Court of Claims, and repeated by Attorney-General Brewster, that under the act of 1866 a report of a code of regulations for the government of the army was made but not acted on. This was evidently a mistake. A system of regulations was prepared by a board consisting of Generals Sherman, Sheridan and Augur, but it does not appear to have been submitted to Congress. A revision of the articles of war was reported, but not, it would seem, a code of regulations.

The act of 1866 was construed by the Court of Claims, the Attorney-General, the second comptroller, and Secretary of War Belknap, to have had the effect of an adoption by Congress of the regulations of 1863, but there has been little agreement as to how long the regulations so adopted remained in force. The legislation has sometimes been regarded as repealed by the repeal provisions (section 5596) of the Revised Statutes, if not already superseded by the act of 15 July 1870, which again provided for the preparation of a system of regulations, to be reported to Congress "at its next session." It has also been held that the regulations of 1863 remained in force, by virtue of the legislation of 1866, until superseded by the regulations of 1881, issued under the act of 23 July 1879, authorizing the Secretary of War to cause all the regulations of the army and general orders then in force to be codified and published. And they have been treated as in force subsequently to this.

After this no revision of the regulations appears to have been undertaken until December 1888, when a board was appointed "for the purpose of revising and condensing the regulations of the army and preparing a new edition of the same." The work of this board finally took the form of the regulations of 1889.

The general regulations, with their accompaniment of manuals, may be regarded as forming the regulations of 1895. One of these manuals — the Manual for Courts-Martial—was not, indeed, a staff manual at all, but is a general system of rules for the administration of military justice. It was the first of its kind promulgated by the War Department, and was an outgrowth and enlargement of the directions on the subject which it was formerly the practice to issue from the headquarters of military departments. Regulations, approved by the Secretary of War, had, however, before this been issued by several of the staff departments for their own government.

The regulations for the United States Military Academy also emanate from the President's constitutional power. There can be no doubt, however, that, within limits, the superintendent of the United States Military Academy, the same as any officer in control of a public institution peopled with persons whose good conduct is entrusted to his charge, may also lay

down rules or regulations. He does, in fact, exercise this power in issuing certain orders. A distinction has, indeed, been made between regulations and orders, but it cannot be said that there is any essential difference between regulations and general orders laying down general rules of action.

As a good illustration of this power, as vested in superintendents of institutions of this character, we may take the various soldiers' homes. For these, certain regulations are prescribed by statute, and others by their boards of managers, necessarily, however, leaving a very considerable residue of matters, principally relating to discipline, to be regulated by the superintendents of the institutions. It may, of course, sometimes be difficult to decide what the limit of the power is, but that the power exists seems clear. Without it, public institutions of this kind could not be controlled, and, therefore, could not be managed for the purpose for which they are established.

Commanding officers of military posts have this power in a marked degree — limited, it is true, in their cases, by statute and regulation of higher authority; but, subject to these, having a distinct, necessary and unquestioned jurisdiction. In this case, however, as also in the case of the superintendent of the Military Academy, the power is a part of an independent military system. But it is the same kind of power that is exercised by the school-teacher in the maintenance of the discipline of his school.

The army regulations issued 15 Nov. 1913, in 80 articles and 1,573 paragraphs, are endorsed as follows by the Secretary of War: "The President of the United States directs that these regulations for the army be published for the government of all concerned, and that they be strictly observed. Nothing contrary to the tenor of these regulations will be enjoined in any part of the forces of the United States by any commander whomsoever."

EDWARD S. FARROW,
Consulting Civil and Military Engineer.

ARMY RESERVE. The regular army reserve, established in 1916, in the United States consists of men not over 45 years of age, physically qualified, who enlist for four years. The President is authorized to assign members of the army reserve as reserves to particular organizations of the army, or to organize the reserve, or any part thereof, into units or detachments as he may prescribe, and to assign to such units and detachments officers of the regular army or of the officers' reserve corps; and he may summon the regular army reserve or any part thereof for field training for not exceeding 15 days in each year, reservists to receive travel expenses and pay at rate of their grades; and in event of actual or threatened hostilities he may mobilize the reserve, and thereafter retain it, or any part thereof, in active service for such period as he may determine conditions demand. All enlistments in the regular army, including those in the reserve, in force on date of outbreak of war, continue in force for one year, unless sooner terminated by order of the Secretary of War. Subject to such regulations as the President may prescribe for proper identification, location and physical condition, members of the army reserve shall be paid semi-annually at the rate of $24 a year while in the reserve.

When mobilized the reserve, while in active service, receives pay and allowances of enlisted men of like grades, including additional pay provided for second enlistments. Upon reporting for duty, and being found physically fit, members of the reserve receive $3 per month for each month they shall have belonged to the reserve, as well as actual necessary cost of transportation and subsistence from their homes to places where they are summoned to report for duty. Service in the reserve confers no rights to retirement or retired pay. Title to pension is attained only through disability incurred on active duty.

The law contemplates that the President may cause reservists to be organized at all times in the manner indicated and that, in the discretion of the President, they may be attached, as such, to organizations of the regular army that are at maximum strength, but when so attached, they are not constituent parts of such organizations and form no part of the numbers authorized by law for such organizations.

ARMY SCHOOL OF THE LINE. See ARMY SCHOOLS.

ARMY SCHOOLS. New inventions and rapid progress in the development of materials cause radical changes in the methods of making war. It is necessary to have post-graduate instruction in many forms to keep pace with modern improvements. The American military educational system now comprises: The United States Military Academy; the Army War College; the Army Staff College; the Army School of the Line; the Coast Artillery School; the Engineer School; the Mounted Service School; the Army Medical School; the Army Signal School; the Army Field Engineer School; the Army Field School for Medical Officers; the School of Musketry; and the Field Artillery School of Fire. There are also schools for training bakers and cooks for the army. The educational scheme contemplates that beginning his career in the garrison school, every officer shall fit himself thoroughly for the duties of his grade while advancing to the Army School of the Line, the Army Staff College and the Army War College; and in this way it is expected that the nation will eventually have at its disposal a highly trained body of officers.

United States Military Academy.— This school was established in 1802 and designed for the practical and theoretical training of cadets for the military service. Upon completing its course satisfactorily, cadets are eligible for promotion and commission as second lieutenants in any arm or corps of the army, the duties of which they have been judged competent to perform. The supervision and charge of the academy are in the War Department under such officer or officers as the Secretary of War may assign to that duty. In conformity with the provisions of section 1331, Revised Statutes, the chief of staff is, by direction of the Secretary, charged with the supervision of matters in the War Department pertaining to the academy. See UNITED STATES MILITARY ACADEMY.

Army War College.— This institution at Washington, D. C., was formerly established

by General Orders 155, 27 Nov. 1901. This order provided for the executive head of the college to be an officer not below the grade of field officer, and for a War College Board to prepare regulations for the government of the college, etc. The objects of the War College are: (a) The direction and co-ordination of military education in the army and in civil schools and colleges at which officers of the army are detailed under acts of Congress and the extension of opportunities for investigation and study in the militia of the United States. (b) To provide facilities for and to promote advanced study of military subjects and to formulate the opinions of the college body on the subjects studied for the information of the chief of staff. The personnel of the Army War College is in part permanent and in part temporary. The permanent personnel consists of a president, to be assigned to that duty by the Secretary of War, and the officers for the time being of the second section, War Department General Staff. Two directors and a secretary of the college are selected from the permanent personnel of the section.

Army Staff College.—The object of this college is to train the selected graduates of the Army School of the Line for the more important staff duties with large commands in time of war. The assistant commandant of the Army Service Schools is the director of the Army Staff College. Selections of student officers are made as follows: (a) They are detailed annually, by the War Department, from the highest graduates of the latest class of the Army School of the Line who receive the recommendation of the academic board, approved by the commandant, and who desire to take the course: provided that an officer once detailed to the Army Staff College, and through sickness or War Department orders, is prevented from completing the course, may be redetailed as a member of a succeeding class, upon the recommendation of the academic board, approved by the commandant. (b) With the exceptions noted under (c) no officer of the army is detailed for instruction in the Army Staff College who has not been graduated at the Army School of the Line with a standing as high as No. 18, exclusive of militia officers, and no militia officer is eligible for admission to the college unless he has been graduated at the Army School of the Line with a percentage as high as that of the regular officer lowest in class standing who has qualified in accordance with the foregoing. No officer is detailed for instruction in the Army Staff College without the recommendation of the academic board, approved by the commandant. (c) In addition to the students who become eligible under (a) and (b) there may be detailed annually by the War Department, upon the recommendation of the academic board, approved by the commandant, not to exceed two graduates of the Army Field Engineer School, who may so desire, to receive instruction in the Army Staff College. To become eligible for such detail, graduates of the Army Field Engineer School must attain a percentage in the course in military art as high as the student officer graduating No. 18 in that course of the Army School of the Line.

The course of study is embraced in four departments, as follows: (1) The department of military art; (2) The department of military engineering; (3) The department of military law; (4) The department of languages.

Army School of the Line.—The object of this school is the instruction of specially selected officers from the line of the army in the proper methods to be employed in the leading and care of troops in time of war, and their training in time of peace. The assistant commandant of the Army Service Schools is the director of the Army School of the Line. Selections of student officers are made as follows: (a) One officer of grade not lower than that of captain and of not less than five years' commissioned service from each regiment of cavalry, field artillery, and infantry serving within the limits of North America and the Hawaiian Islands, and such other officers as are hereinafter specified. Officers are not detailed from regiments in service, or about to serve in the Philippine Islands, but in lieu thereof additional officers may be detailed from regiments of the same arm which have most recently returned, or are about to return, from Philippine service to home stations; but not more than five officers are detailed from the field artillery for any one class. (b) The commanding officer of each regiment of cavalry, field artillery and infantry serving within the limits of North America and the Hawaiian Islands submit directly to the adjutant general of the army, not later than 1 January of each year, the names of two officers (one as principal and the other as alternate) recommended for instruction at the school. From the officers thus recommended selections are made by the Secretary of War. (c) In a similar manner, the chief signal officer of the army may annually recommend one permanent officer of his corps, with the same limitations as to grade and length of service. The course of study is embraced in three departments, as follows: (1) The department of military art; (2) The department of military engineering; (3) The department of military law.

For Coast Artillery School, School of Fire for Field Artillery, School of Musketry, School for Bakers and Cooks, Post schools for the instruction of enlisted men, Garrison schools for the instruction of officers in subjects pertaining to the performance of their ordinary duties and the military departments of civil institutions at which officers of the army are detailed under the provisions of law, see MILITARY EDUCATION.

Army Field Engineer School.—The object of this school is (1) the instruction of officers of the corps of engineers and of engineer officers of the organized militia in their military duties; (2) To furnish such instruction in military engineering as the schedules of the other schools comprising the Army Service School may call for. There is detailed a field officer of the corps of engineers to report to the commandant of the Army Service Schools for duty as director of the Army Feld Engineer School. Selections of student officers will be made as follows: (a) The chief of engineers may submit to the adjutant-general of the army, not later than 1 January of each year, the names of not less

than 2 nor more than 10 officers of the corps of engineers, of grade not below that of captain, for instruction in the school. (b) There may also be detailed such engineer officers of the organized militia as may apply for entrance, subject to certain provisions. The course of study is embraced in two departments, as follows: (1) The department of military engineering, (2) The department of military art.

Army Field Service School for Medical Officers.— This school consists of two parts: (1) The Field Service School for Medical Officers, at which attendance in person for the pursuance of a graded course of study is required; (2) The Correspondence School, wherein answers and solutions to such questions and problems as may be sent to designated medical officers, at their posts or stations, are required. Its object is in the Field Service School: (a) To instruct officers of the medical corps and medical officers of the organized militia in their duties as administrative and staff officers on field service, and to make research into such subjects as may concern medical officers under field conditions. (b) To give such technical instruction to students in the other schools as the schedules of those schools, approved by the commandant, may call for. In the Correspondence School: (c) To afford opportunity for such wider elementary instruction in the methods and purposes of military plans and movements as will enable medical officers of the regular army better to fulfil their duties in the field; and to prepare them to participate to better advantage as students in actual attendance at the Field Service School for Medical Officers. There is detailed a field officer of the medical corps to report to the commandant of the Army Schools for duty as director of the Army Field Service and Correspondence School for Medical Officers. The course of study is conducted under the School for Medical Officers and covers a period of not less than six weeks between 1 April and 15 May of each year. Selection of student officers is made as follows: (a) The surgeon-general will submit to the adjutant-general of the army not later than 1 January of each year the names of not less than four nor more than eight officers of the medical corps whom he recommends for Medical officers of the organized militia who may apply for entrance and whose admission detail for construction in this school. (b) may receive the approval of the Secretary of War, not to exceed a total of six in any one session, may also be detailed for instruction in the school subject to certain provisions. The course of study is conducted under the Field Service School for Medical Officers, the Army Staff College and the Army Field Engineer School. Its details are prepared by the director of the Army Field Service and Correspondence School for Medical Officers, in co-operation with the directors of the Army Staff College and the Army Field Engineer School subject to the approval of the commandant.

Army Signal School.— The object of this school is: (1) To prepare officers of the signal corps for the better performance of the duties of their profession, to provide instruction in signal duties for such officers of the line as may be designated therefor, and to make research and practical experiments in such subjects as relate to the duties of the signal corps. (2) To supplement the instruction given in the Army School of the Line and the Army Staff College along the special technical lines of the signal corps, as called for by the schedules of the latter schools, having especially in view the relation of the signal corps to the whole army and the function it fulfils in time of war. There is detailed a field officer of the signal corps to report to the commandant of the Army Service Schools for duty as director of the Army Signal School. Selections of student officers are made as follows: (a) The chief signal officer of the army may submit to the adjutant-general of the army, not later than 1 January of each year, the names of not less than two nor more than five officers holding permanent appointments in the signal corps for instruction in the school. (b) Also there may be detailed such officers of the rank of captain or first lieutenant from the army at large as may make application to the adjutant-general of the army and receive the recommendation of the commandant of the Army Service Schools, provided that the total number of officers detailed under (a) and (b), exclusive of militia officers, shall not exceed 15; also such signal officers of the organized militia as may apply for entrance, subject to certain provisions. The course of study is embraced in three departments, as follows: (1) The department of signal engineering; (2) The department of topographs; (3) The department of languages.

The whole scheme of the army schools results from a fixed policy, the object of which is to make the army as perfect as possible, not only in the performance of its own duties, but in its capacity as instructor for the hundreds of thousands of citizen soldiers necessary in any war of magnitude. See MILITARY EDUCATION.

EDWARD S. FARROW,
Consulting Civil and Military Engineer.

ARMY SERVICE CORPS, in the British army, is the commissariat and transport department. The corps is organized in 51 horse transport companies, 18 mechanical transport companies, 5 supply companies, and 4 remount companies. The transport companies are stationed at the various large garrisons at home and in the colonies, and all the transport services required by the troops are carried out either by these companies or by civilian transport hired from local contractors and carried out under the supervision of army corps officers. In large stations like Aldershot, where there are huge army abattoirs and bakeries, not only is the food issued, but it is actually prepared by the army service corps. The mechanical transport companies are a modern creation; they utilize three grades of motors — heavy, medium and light — drawing from one to five 4-ton trucks. The remount companies have the care of the young horses at the government depôts, and are mainly composed of men transferred from the artillery and cavalry. For active service the A.S.C. units are formed into "trains" and "supply columns," one column being attached to each division (infantry or cavalry), each brigade and each field army. The field bakery attached to each divisional train and supply column is

capable of baking bread for 26,000 men. The strain thrown upon the A.S.C. in war time is enormous. By day and night a never-ending procession of A.S.C. trucks plough along the roads and through the mud behind the firing line, often traveling great distances from the base to carry food, clothing, munitions, medicaments and innumerable other items roughly classified as "stores" to the men on the battlefield. His Royal Highness, the Duke of Connaught, is colonel of the corps.

ARMY SERVICE SCHOOLS. In addition to the Military Academy at West Point, which trains candidates for commissions in the army, certain schools are maintained for the instruction of selected officers and men in their duties after they have been admitted to the service. These are the Army War College at Washington, D. C.; the Army Staff College at Fort Leavenworth, Kan.; the Coast Artillery School at Fort Monroe, Va.; the Engineer School at Washington Barracks, D. C.; the Mounted Service School at Fort Riley, Kan.; the Army Medical School (q.v.) at Washington, D. C.; the Army Signal School at Fort Leavenworth, Kan.; the Schools for Bakers and Cooks at Washington Barracks, D. C.; the Presidio of Monterey, Cal.; Fort Sam Houston, Tex.; Fort Shafter, Hawaii; Fort Riley, Kan.; Fort William McKinley, P. I.; the Army Field Service and Correspondence School for Medical Officers, Fort Leavenworth, Kan.; the School of Fire for Field Artillery, Fort Sill, Okla.; the School of Musketry, Fort Sill, Okla.; the Signal Corps Aviation Schools at San Diego, Cal.; Mineola, New York; and near Chicago, Ill.; the United States Army Balloon School at Fort Omaha, Neb.; and the Ordnance School of Application, Sandy Hook Proving Ground, N. J. Certain of these schools are not under the command of the commander of the department in which they are situated, except in matters concerning courts-martial. Many of them have special details of enlisted men attached to them permanently. See also ARMY SCHOOLS.

ARMY SIGNAL SCHOOL. See ARMY SCHOOLS.

ARMY SIGNAL TROUPS. See MILITARY SIGNALLING AND TELEGRAPHING.

ARMY STAFF COLLEGE. See ARMY SCHOOLS.

ARMY STAFFS. The general commanding a large body of troops must have assistants to generally supervise the fighting forces under his command. These assistants form his "staff." To a certain extent, an arbitrary rule decides what portion of the latter is designated as "general staff." In some armies all the staff belongs to the general staff, but a necessity has universally been felt of having a distinct portion of the staff entrusted with planning and carrying out the movements of armies in the field, and generally distinguished by some special name.

The enormous numerical strength of modern armies, and the way they must be organized to meet the constantly changing requirements of war, render an immense amount of detail necessary in carrying out military operations even under apparently similar circumstances of time and place. Thus the higher leaders and commanders necessarily require the permanent support of specially selected and trained officers. But there is another case in which this necessity of assistance is felt, and which is more intimately connected with the handling of troops in action, viz., the reconnaissance of the ground and of the positions and movements of the enemy, and the observation of the state of affairs in an engagement, at a point removed from the personal observation of the general commanding.

It is now considered part of the duty of the general staff to be invariably watching over the military efficiency and material welfare of the troops. On every large staff all branches of the service are represented by certain individuals or heads of departments, and it is naturally their duty, in the first place, to see to the proper efficiency of their respective branches or departments; but being often ignorant of the general military situation, or not rightly understanding sudden changes in the state of affairs, they are unable to carry out what is expected from them. The general staff is consequently called upon to act as a directing and explaining body toward these individuals by keeping itself in constant communication with them, the chief of the general staff being at the same time regarded, in a general way, as head of the whole staff.

Officers of the general staff are invested with no military command. But even without having any command they can make themselves extremely useful in an engagement by carrying out any special and important duties that may be entrusted to them by the general commanding, in addition to devoting themselves to their general duties. Their usefulness in this respect will be found to depend not only on their fitness and ability, but on their tact and discretion as well, in rightly appreciating the position they hold, both as regards general and troops. The conditions to fulfil this, however, are not entirely one-sided. Troops very soon find out, especially in war, whether the duties of the general staff are in good hands.

The duties of the general staff in war are: 1. Working out all arrangements necessary for quarters, precautions against surprise, movements and battle; 2. Communicating the necessary orders, either verbally or in writing, at the right time and place, and in sufficient detail; 3. Obtaining, collecting and compiling in order all information concerning the nature and the military character of the theatre of war; 4. Collecting and estimating the value of information received concerning the enemy's forces; 5. Watching over the fighting condition of the troops, and being constantly informed of their efficiency in every respect; 6. Keeping journals and diaries, drawing up reports on engagements, and collecting important materials, to afterward form a history of the war.

General staff officers have to take, as a basis for carrying out their duties in all the branches that have been assigned them, the wish and determination of the general in command, in which, however, initiative on their part is by no means excluded, but rather invited. A general staff officer cannot excuse himself for any neglect on his part on the plea that no order on the subject had been given him by his general. He should only consider himself freed from responsibility when his sug-

gestion has been declined by the general. This gives rise to no small amount of constant responsibility, which rests anything but lightly on the shoulders of the general staff in war, and which obliges it to be devoted to an untiring energy.

The "great general staff," a body of general staff officers who are not attached to any corps, is entrusted, under the immediate supervision of the chief of the general staff, with drawing up and preparing schemes for the strategical concentration of the army in certain particular directions by road and rail, with collecting and estimating the strength, etc., of the various armies, with the study of theatres of war, and with the preparation of military maps. It is also employed in promoting military science, especially military history, and in the supervision of the training of young officers.

The general staff corps, United States army, is composed of officers detailed for service in said corps for a period of four years, unless sooner relieved, under rule of selection prescribed by the President. Upon being relieved from duty in the general staff corps, officers return to the branch of the army in which they hold permanent commissions, and except in case of emergency or in time of war are not eligible to further detail therein until they have served for two years with the branch of the army in which commissioned. This ineligibility does not apply to any officer who has been relieved prior to the expiration of four years' duty with the corps; but such officer will become ineligible as soon as he shall have completed a total of four years of said duty. While serving in the general staff corps officers may be temporarily assigned to duty with any branch of the army.

The general staff corps, under the direction of the chief of staff, is charged with the duty of investigating and reporting upon all questions affecting the efficiency of the army and its state of preparation for military operations, and to this end considers and reports upon all questions relating to organization, distribution, equipment, armament and training of the military forces, proposed legislative enactments and general and special regulations affecting the army, transportation, communications, quarters and supplies; prepares projects for manœuvres; revises estimates for appropriations for the support of the army and advises as to disbursement of such appropriations; exercises supervision over inspections, military education and instruction, examinations for the appointment and promotion of officers, efficiency records, details and assignments, and all orders and instructions originating in the course of administration in any branch of the service which have relation to the efficiency of the military forces; prepares important orders and correspondence embodying the orders and instructions of the President and Secretary of War to the army; reviews the reports of examining and retiring boards, and acts upon such other matters as the Secretary of War may determine.

The general staff corps, under like direction, is further charged with the duty of preparing plans for the national defense and for the mobilization of the military forces (including the assignment to armies, corps, divisions and other headquarters of the necessary quota of general staff and other staff officers), and incident thereto with the study of possible theatres of war and of strategic questions in general; with the collection of military information; the preparation of plans of campaign, of reports of campaigns, battles, engagements and expeditions, and of technical histories of military operations of the United States.

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ARMY TERRITORIALE. As soon as the men complete nine years service in the French army, and reserve, they are transferred for five years to the army territoriale, and after its expiration are transferred for six years to the reserve of the army territoriale, when their liability to military duty ceases. The army territoriale embraces troops of all arms and is organized substantially on the same basis as the regular army.

ARMY TRANSPORT SERVICE. At the outbreak of the war with Spain the water transportation in the possession of the United States consisted of a few small tugs, ferryboats and launches. Suddenly confronted with the necessity of dispatching armies across the seas, it is not surprising that some confusion and delay were encountered in selecting, chartering and assembling fleets capable of transporting troops, with their guns, animals and impedimenta, to Cuba, Porto Rico and the Philippine Islands. To convert the vessels composing the several fleets from ordinary freightships into commodious and comfortable troop-transports required time and much outlay. The arrangement of sleeping accommodations for the men, stalls for the animals, increased water-supply and ventilation involved a practical reconstruction of the interior of every vessel. It was particularly necessary to have those vessels destined for the Philippines made safe and comfortable, for it was anticipated that the troops might pass direct from the decks to the battle-field. Hospital ships were fitted out as quickly as possible and served a useful purpose during the time of greatest need.

It was apparent at the outset that the problem of water transportation required careful and continuous study, and immediately after the surrender of Santiago de Cuba a division of transportation was created by the Secretary of War and charged with supervision and control of all rail and water transportation; with the inspection of ships with reference to charter or purchase for use as transports, and with the arrangements for sending troops by rail to and from the various ports. When it became apparent that vessels would be required for a prolonged period, and that it was a very expensive proceeding to alter chartered vessels, the department began to purchase such ships as seemed best adapted to use as transports. Aside from the mere act of affording a passage to troops across the seas, the question of furnishing them supplies after landing involved many intricate problems, each requiring a special solution. American troops submit cheerfully to any amount of necessary hardships, but consider themselves entitled to the best of everything, regardless of cost, when the emergency has passed. For supplying their needs, it was necessary to construct refrigerator com-

partments in the transports to carry fresh beef and other perishable stores to the most remote and hitherto little known islands of our new possessions.

During the first few months of the heavy demands for transportation, the quartermaster's department was much hampered because vessels of foreign register could not be employed for the service and Congress refused to grant American register to such vessels. Nevertheless, by 1 July 1898, 43 chartered vessels had been secured and fitted up for the transportation of troops, animals and supplies. The difficulties and expense attendant upon securing efficient service with chartered vessels led to the gradual substitution of transports purchased by the government and permanently fitted up as troopships. The largest and best transports averaged nearly 6,000 tons capacity; and when, after some practical experience, a general plan of fitting up had been adopted, the transport service became a prominent feature of army administration, and attracted the attention and admiration of the civilized world. The urgency of the situation on the Pacific compelled a continuance of the charter system; but a fleet of government transports was gradually put in commission on the Atlantic, and as soon as the withdrawal of the volunteer army from Cuba permitted, many of the transports were sent to Manila by way of the Suez Canal and put on the San Francisco-Manila route. The *Grant*, *Sherman* and *Sheridan* were the first vessels fitted out for this service, and their sailing from New York for Manila marked a new era in the occupation of the Philippines. The character of these transports may be comprehended by the statement that the *Grant* sailed from New York on 19 Jan. 1899, with the 4th United States infantry and one battalion of the 17th United States infantry, with a total strength of 50 officers and 1,703 enlisted men. The *Sherman* sailed on 2 February with the 3d United States infantry and one battalion of the 17th United States infantry, with a passenger list of 1,812 persons, followed by the *Sheridan* on 19 February with the 12th United States infantry and the 3d battalion, 17th infantry, with a total passenger list of 2,017 persons. These vessels made the long voyage to Manila with such success and comfort that the regiments were enabled to enter immediately upon active service. The experience of these voyages dictated some valuable suggestions, which were availed of at once in making desirable changes to perfect the transport service generally.

The large number of troops remaining in Cuba and Porto Rico after the return of the main body of regulars and volunteers necessitated the establishment of a regular line with weekly sailing dates. Advantage was taken of the regular steamship lines as far as possible for the larger movement of returning troops. The transportation to Spain of the Spanish prisoners was accomplished under contract, in accordance with stipulations under which the surrender of Santiago took place. More than 22,000 Spanish prisoners were thus returned from the eastern end of Cuba to Spain within 60 days of their surrender, in an economical and apparently satisfactory manner.

The outbreak of the insurrection in the Philippines made it necessary to hasten relief to the volunteer regiments still held in those islands, and the presence there of the old Spanish garrisons which, under the terms of the treaty of peace, were entitled to repatriation, made it desirable that they should be returned to Spain without delay. The transport service was strained to the utmost limit, but fulfilled its part in the most gratifying manner. During its first year of existence a total of 202,587 passengers were transported across the seas by army transports without responsibility for the loss of a single life.

The question of transportation of animals was one requiring much study and experiment, for there was little experience available to guide the department in a solution of the problem of landing cavalry horses in fit condition for service after a voyage of 7,000 miles. Some discouraging losses of mules occurred at a critical moment in the campaign against the insurgents, but gradually the system was perfected and the loss of animals actually reduced below the percentage of loss from injury and disease which should be expected in the herds on shore. Nearly 20,000 animals were transported during the year ending 30 June 1901.

At a time when every effort was being put forth to meet the requirements of the military situation Porto Rico was devastated by a hurricane, and the transport service was called upon to distribute relief stores to the unfortunate inhabitants who, just released from the worries of war, found themselves threatened with famine and pestilence.

As conditions in the Philippines gradually settled down to a guerilla warfare the troops were distributed at about 400 stations, necessitating an inter-island transport service. Just as everything was becoming adjusted to the new conditions which followed the dispersal of Aguinaldo's army the unfortunate "Boxer" outbreak took place in China. The experience already obtained enabled the department to handle the transportation question in such a way as to win the admiration of all the foreign contingent composing the Chinese relief expedition which finally entered the sacred city of Pekin.

Following the signing of the treaty of peace with Spain it was necessary to maintain a considerable force in Cuba during the period required to establish the new government of the island upon a reasonably stable basis. Spain had for many years garrisoned the island with a force several times as large as the entire United States army. Affairs gradually assumed a normal condition and on 30 June 1901 the transport service between the United States and the islands of Cuba and Porto Rico was discontinued.

Under the American volunteer system the men were enlisted for the war with Spain under contracts calling for two years' service or during the war. With the signing of the treaty of peace it had been necessary for Congress to authorize the enlistment of 35,000 volunteers to assist the regular army in putting down the insurrection in the Philippines and permit of the discharge of those who had enlisted for the war with Spain. In its refusal to increase the regular army and its substitution of a force of volunteers whose enlistments should not extend beyond 1 July 1901, Congress found itself confronted again with

the necessity for keeping faith with the 35,000 volunteers, and arrangements were made to transport them home before their enlistments should expire.

The records show that more than 500,000 passengers had been safely transported across the seas, in some instances as much as 11,000 miles upon single voyages, without the loss of a passenger due to the transport service.

Following the discharge of the volunteers and a reorganization of the regular army in 1901, the number of transports was reduced by disposing of the least efficient in respect to carrying capacity and economy of operation. The vessels retained in service represented the finest types of transports then in the service of any nation. They contained all the improvements suggested by several years of extended experience and were of the tonnage deemed most economical for the peculiar service required. Until very recently when Congress authorized utilization of space for non-military freight from the congested ports of the Philippines, there was little cargo on the homeward run. The space was usually utilized for coal from Nagasaki where the cheapest fuel on the Pacific shores is available. The question of fuel supply for American ships in the Pacific is a very serious one and will not be solved until the coal fields of Alaska become available. Vessels of American register are handicapped in several ways in their competition with Japanese ships and cheaper fuel than heretofore available on our Pacific coast is a maritime necessity.

The second occupation of Cuba required the restoration of the service in the Atlantic which was continued until the final evacuation of that island by American troops during the spring of 1909, concerning which the quartermaster-general reported: "The movement was made without delay or casualty and the troops arrived at their final stations in the United States in good condition. The dispatch and ease with which this movement was accomplished, without instructions from this office other than general directions for operations under the decentralization system, show conclusively the thorough efficiency with which field operations may be conducted according to that method."

Upon conclusion of this movement the small fleet of Atlantic transports was again withdrawn from service and the vessels laid up at Newport News, Va., where they remained until the conditions in Mexico brought about the concentration of the second division of the army at Galveston and Texas City with a view to meeting any emergencies. The transports were speedily put in commission and assembled in the harbor of Galveston where they remained until their services were demanded for the movement of troops to Vera Cruz, and then to maintain their connection with the base of supplies. During the continuance of the revolution in Mexico transports have been used to bring home American citizens from both Atlantic and Pacific coast ports. With the withdrawal of troops from Vera Cruz the Atlantic transports were again ordered out of commission to await the next of the recurring calls for oversea service to which the American army has been so frequently summoned since the war with Spain pushed the frontier of our altruistic and trade interests beyond our territorial borders.

The Pacific transports have continued a monthly schedule of sailings between San Francisco, Honolulu, Guam and Manila. Guam is maintained as a naval station and the only regular communication is by the monthly transport going to Manila. On the homeward-bound voyage the transports sail via Nagasaki and take on coal. From Nagasaki the voyage continues direct to Honolulu and San Francisco, passengers from Guam for the United States being compelled to make the long detours. The traffic has materially increased since the garrisons of Oahu and Guam have been enlarged, and averages over 2,000 passengers per month.

The Pacific fleet has continued the transportation of horses and mules on a special horse transport which has been a pronounced success from the beginning. The delivery of animals in condition for immediate service after voyages of upward of 7,000 miles continues to elicit the admiration of the army. The laying of cables has been not the least important work of the transport service in the Philippines and Alaska. A very large and seemingly growing amount of passengers and freight has been carried for the navy and civil governments of the several island dependencies. Without the accommodations afforded by the transports it would be impossible for the families of civil, military and naval officers and soldiers to follow them across the seas. The inter-island service in the Philippines has covered an enormous number of voyages since the occupation of those outposts began, and now the needs of the garrison at Tientsin, China, are supplied by those vessels having Manila for a base.

When the success of the transport service had become widely known the propriety of its continuance in competition with commercial liners was frequently under discussion and attracted the attention of Congress. The matter was settled in favor of the continuance of the transports by the enactment of legislation at the session of 1902-03, providing that the service should not be abandoned without the consent of Congress.

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ARMY TRANSPORTATION. The European War has made a radical change in the systems of army transportation. Both strategy and tactics have been affected by motor transport. The strategical mobility of troops has been increased, and they have been rendered less dependent upon lines of communication. The increased size of armies engaging in warfare make necessary the more rapid concentration of superior forces. While armies are being mobilized, concentrated and engaged in warfare, they must be fed, clothed and furnished with ammunition. The development of railroads has had a decided effect toward making possible the rapid mobilization and concentration of armies; but, as the locomotive is tied to the rails, it necessarily follows that it cannot always move immediately with the army. So exorbitant is the demand on the sources of supply for draft animals in any modern war that the question of mechanical

transportation has become one of great military interest, and no military man will deny the fact that the army which can mobilize and concentrate most quickly, and can most rapidly advance after concentration, will have a decided advantage over its opponent.

It is also true that the expense of carrying on a modern war is so great that no nation can neglect to take advantage of every means that will have a tendency to shorten the war and bring about a decisive conclusion. Troops must be fed and it is hardly possible that in any theatre of war in the future sufficient subsistence for hundreds of thousands of troops can be secured by means of forced contributions. Especially will this be true of the advancing army which will have to traverse the territory over which the retiring army has already passed, and which it has already devastated. The immense amount of ammunition expended in modern battles makes its supply more important and difficult. The use of heavy artillery is absolutely necessary, and the transportation of this class of artillery and the ammunition for it adds another difficulty and materially increases the demands on the transportation of an army. The extensive frontage of 50 to 100 miles occupied by large modern armies in the field makes more difficult the distribution of supplies to the smaller units. These and other considerations make it more imperative that no practical means be neglected whereby an army may more quickly and efficiently supply its parts and reduce the necessity for draft animals.

With the development of firearms has come an increase in the distance that must be observed between the parts or elements of a column on the march. With the increased size of armies has also come the necessity for the utilization of more roads in an advance or retreat, as the principle still holds that only about 30,000 men may use the same road on the same day for the purposes of a march; and thus is increased the frontage of an army on the march. This has brought about the necessity for a more effective means of communication between the parts of a column and between the different columns. As the commander of an army will often be separated from some parts of his army by a distance of 40 or 50 miles, his personal observation of the conditions existing at the front are absolutely prevented unless he employs some more effective means of travel than that furnished by the horse. The signal troops, with telephone and telegraph, have supplied the means of communicating; but even these sometimes fail, and, at most, they do not furnish to the commander of the army that detailed information and that understanding of the situation which he can get from a personal observation.

Animal Transportation.— Motor vehicles deteriorate rapidly under the service demanded in war and are very vulnerable to missiles. Beyond their limited sphere of utility, other facilities for transportation must be provided. On good roads and for long drives, the motor truck is very satisfactory. On bad roads and for short hauls, horse power is more economical and much more satisfactory. The latter must, therefore, still supply the principal means of transportation over muddy roads and ploughed fields, across streams and ditches and up steep slopes. Experiments conducted at the University of Wisconsin have indicated that, due to the intelligence with which the horse applies his motive force, and to the flexile qualities of the latter, the efficiency of the horse as a traction agent is much higher than the horse power developed would alone indicate.

The heavy purchases of horses made by the European belligerents show clearly that experience in the field caused a renewed recognition of the important place of the horse in the work of war. The best estimates indicate that there were purchased in the United States alone, for use in the European War, about 1,000,000 horses at an average initial price of about $170, increased by a further cost for transportation, etc., of from $115 to $130. This makes the average cost of the horse, landed in Europe, from $300 to $315. If the millions expended for horses as above did not show sufficiently their recognized importance in the face of all competition from motor vehicles, further proof of their essential place in war is found in the greatly improved arrangements, visible in all the belligerent armies, for the care and preservation of the animals and for the prompt treatment when wounded.

Railroad Transportation.—In time of war, the railroads give life to armies, provide food, clothing, materials and munitions rapidly. They give freedom and vigor in the movement of large bodies of troops, remove sick and wounded rapidly, deliver reinforcements promptly. In fact, the railroad is indispensable in utilizing a nation's forces to their greatest capacity and with the maximum effect.

Germany has a highly developed and brilliantly organized military railroad service. They had on hand in 1914 at the outbreak of hostilities all material and rolling stock necessary for the transportation and concentration of men, animals and materials. Tables for the dispatch and conduct of trains were all ready. The system for handling sick, wounded and prisoners was carefully worked out. The principal reason for the superiority of the Germans over their adversaries was that their railroad systems were perfectly organized, allowing them to mobilize much more rapidly and giving them greater mobility in operations. It might almost be said that their plans of war consisted of the judicious and intensive development of their railway systems. There are nine railroad lines, each absolutely independent of the others, operating in the province of Lorraine. Seven days was the maximum required to put all the first line troops on the frontier, and on the 10th they invaded France. On the west front, the great bases are Düsseldorf, Cologne, Coblenz, Mayence, Mannheim, Strassburg and Leopolsche. The bases on the east front are Danzig, Thorn, Posen, Ostrowa, Breslau, Myslowitz and Cracow. These great bases are linked in all their enormous extension by 800 kilometres of line separate from the nine great lines connecting the two fronts.

France had her railroad service well organized and almost all the materials and rolling stock required was on hand. The railroad service was divided into two divisions of subservices (1) Transports over the interior system; (2) transports over the army systems. The interior system receives orders from the Minister of War and the army system receives

its orders from the commander-in-chief of the army only. To insure normal functioning of these services, "regulating stations" were established in regions of notable importance and in favorable situations. An officer of the general staff had charge of each of these stations. Having helped in the preparation of the general plans of mobilization, he had a perfect knowledge of the conditions to be met. Rapid transportation of artillery and its prompt entrance in great masses into the conflict is possible only if railway facilities exist and are used. When Paris was threatened, the French brought an entire army from the south in a few days.

Wagon Transportation.— Wagon trains are slow moving, excessively wasteful of road space and very vulnerable. The train guard must fight to save its convoy if attacked and its excessive length requires a large force to ensure its safety. A few mules dropped and the road is effectively blocked. Consider an auto train carrying the same quantity of stores. It will be about one-sixth the length of the wagon train. Its comparatively small cavalry escort, scouting well to the front and flanks, will notify it of danger in time to permit a counter-march and a retreat which will soon easily outdistance pursuit by even cavalry. A hundred shots might hit the truck without damaging the engines and a bullet-proof shield could easily be provided to protect the chauffeur. The empty wagons returning to the base are supposed to carry sick and wounded, to assist in the prompt evacuation of the field hospitals.

A brigade wagon train in service in the field will vary from 70 to 100 wagons and teams, according to the strength of the brigade, the distance from the depots or base of supplies, the character of the roads, nature of the climate or season of the year. Such a brigade train on the march, allowed to go at will, as the roads average, will take up a mile of road. For convenience of handling it, the brigade train should be divided into three parts of from 20 to 25 wagons each. These lesser divisions of the train should march slightly separated from each other. Should they have to leave the road, or halt on the march, each separate train should pull out at the same time into a field or open space, and be parked *with the mules facing the road*. In such position, all the trains can *simultaneously* pull into the road and occupy their proper space and distances without consuming time in waiting for each other. If parked with wagon tongues toward the road, the train is ready to march in either direction which necessity shall require. If the teams are parked three or four deep, that number can start simultaneously at the word.

In Europe nearly all the work of transportation from railroad is by motor. To give some idea of the extent of the transportation problem, the example of a division may be taken. This is the administrative and tactical unit and comprises 22,665 men, 4,463 horses and 2,912 mules. The daily march averages 12½ miles and the road space is 15.4 miles. The daily supplies of a division weigh 175,000 pounds. The net cargo in the supply trains of a division, exclusive of pack trains and artillery ammunition, is 2,143,000 pounds. These supplies and the regularity of renewal are essential to the well-being and morale of an army.

Lines of communication comprise the base section, where supplies are accumulated and forwarded by rail and boat; the intermediate section, comprising the transportation routes to railroad; and the advance section, where is found the great problem of the daily renewal of the supplies expended, amounting to 175,000 pounds for a division. The division supply train carries two days' food for the men and two days' forage for the animals. The division train transports supplies from the refilling point to the distributing point, whence distribution to the troops is made by the ration and field trains. On wagon transportation, capable of a daily movement of only 18 miles, a division has a very limited radius of action from railhead.

Ammunition expenditure, both artillery and small arms, is enormous, and transportation must be provided accordingly. The daily expenditure per man for small arms ammunition, formerly calculated at 240 rounds, is now calculated at 1,000 rounds per day in action. The Germans have 48 machine guns per regiment.

For efficiency in supply, proper organization must be had in the transport. In motor transport, the unit is the truck, its driver and his helper, and the best truck for general purposes appears to be the 1½-ton truck. These units must be organized into companies. Companies must be limited to the number of trucks that can be properly supervised by one man, and also to the number that can be properly served by one supply and repair truck. In addition to the supply and repair truck, arrangements must be made for shops where more extensive repairs can be made.

The most convenient and efficient division supply train is made up of two units, each comprising 60 baggage trucks, 1½ ton; three fuel supply trucks; three repair trucks; one office truck; four high-speed cars for officers; eight motorcycles. This corresponds to an organization of squads of five trucks, two squads to a section, two sections to a platoon and three platoons to a company, with a personnel of a captain, three lieutenants and 154 men.

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ARMY-WORM, the caterpillar of the moth *Leucania unipunctata*. The adult measures about one and a half inches across the expanded wings, which are dull brown, the anterior pair bearing near the centre a small white dot which has suggested the specific name. Like most moths, this species flies at night and, in seasons when they are specially abundant, are the most commonly captured insects at lights and baits of sugar or syrup, of which they are very fond. The eggs are usually concealed on herbage in fields, especially where vegetation is luxuriant, as in wheat fields. Unless checked by enemies the caterpillars quickly reach maturity, pupate a short time under ground, emerge, pair and lay eggs from which a larger brood than the first is hatched. This brood, after devouring every green thing soft enough to eat, spread destruction as they march, army-like, from the place where they were hatched to fresh feeding grounds. When full grown these larvæ pupate; some for only a short time, others until the following spring. The former lay eggs for a third brood of caterpillars which endeavor to pass the winter as

larvæ, so that larvæ, pupæ and adults may be found throughout the year. The caterpillars attain a length of about two inches, are dark gray, striped with light yellow and green. Though annually common east of the Rocky Mountains they are generally so well controlled naturally that their depredations are insignificant, and usually when they do become a pest their enemies so quickly master them that they very rarely are troublesome in the same locality two years in succession. The most important of these enemies are fungous diseases and, especially, parasitic insects. Artificial controls are almost all mechanical. Occasionally the larvæ of the first brood may be noticed in time to apply an insecticide (q.v.) such as Paris green mixed with soap-suds instead of water to make it more adhesive to the grass; but usually the safest plan is promptly to bury the crop by plowing, or to burn it. If migration has started a strip of land should be ploughed across the line of march, harrowed and rolled constantly to crush the worms, or kerosene emulsion, diluted only five times, must be sprayed upon the advancing worms and also upon their recent feeding ground. The name army-worm is given to other species of caterpillars, especially to *Laphygna frugiperda,* which is better known as grass-worm. Consult 'Third Report' United States Entomological Commission (Washington 1883); 'Bulletin 133' Cornell Experiment Station.

ARN, ARNO or **AQUILA,** bishop and archbishop of Salzburg: b. c. 750; d. 24 Jan. 821. Entering the Church at an early age, he became abbot of Elnon or Saint Amond. In 785 he became bishop of Salzburg, and in 787 was an envoy to Charlemagne at Rome for Tassilo III, Duke of the Bavarians. The Frankish King made Salzburg an archbishopric in 798 and Arno became first archbishop metropolitan of Bavaria and received the pallium from Pope Leo III. From that time he began to take an active interest in the government. He spent some time at the court of Charlemagne; established a library at Salzburg and presided over several synods for the improvement of the condition of the Church in Bavaria. With the aid of a deacon named Benedict, Arn drew up a catalogue of lands belonging to the Church of Bavaria under the title of 'Indiculus' or 'Congestum Arnonis' (Munich 1869, published with notes by F. Keinz). Many other works were produced under his protection. An edition of a consuetudinary of Salzburg appeared in 'Quellen und Erörterungen zur bayrischen und deutschen Geschichte' (Vol. VII, edited by L. Rockinger, Munich 1856). W. Von Giesebrecht considers Arn the author of an early history of the Frankish kings from 741–829, in 'Annales Laurissenses majores,' an edition of which appears in 'Monumenta Germaniæ historica Scriptores' (Vol. I, pp. 128–31, ed. by G. H. Perz, Hanover 1826). This work is the first to apply the name "Deutsch" to the German language.

ARNA, or **ARNEE,** är'nē, large animal of the ox genus, a native of India and the Indian Archipelago. See BUFFALO.

ARNAULD, är-nō', ancient noble family, among whose most distinguished members are the family of Auvergne. (1) ANGELIQUE: b. Paris, 24 Nov. 1624; d. 24 Jan. 1684. She was the granddaughter of the great Arnauld and was abbess of the famous nunnery of Port Royal from 1678. Consult Lives by Martin (1876); Monlaur (1901) and 'Angélique of Port Royal' (1905). (2) ANTOINE: b. Paris 1560; d. 1619. He was a zealous defender of the cause of Henry IV, and was distinguished for several political pamphlets and for his powerful and successful defense of the University of Paris against the Jesuits in 1594. He drew on himself the hatred of the Jesuits, but was esteemed the greatest lawyer of his time. His numerous children formed the nucleus of the sect of the Jansenists (see JANSENIUS) in France. (3) ANTOINE, called the "Great Arnauld," youngest child of the lawyer Antoine Arnauld: b. Paris, 6 Feb. 1612; d. Brussels, 9 Aug. 1694. He devoted himself to theology, and was received in 1641 among the doctors of the Sorbonne. In the same year he attacked the Jesuits in two works, 'De la fréquente Communion' and 'La Théologie Morale des Jésuites,' the first of which occasioned much controversy because it applied the principles of the Jansenists to the receiving of the sacrament. After 1650, when Jansenism had become an object of public odium and the watchword of an important party in the state, Arnauld engaged in all the quarrels of the French Jansenists with the Jesuits, the clergy and the government, was their chief writer and was considered their head. The intrigues of the court occasioned his exclusion from the Sorbonne (1656) and the persecutions which compelled him to conceal himself. After the reconciliation between Pope Clement IX and the Jansenists, in 1668, he appeared in public and enjoyed the homage which even the court did not refuse to his merits and talents. He now attacked the Calvinists in many controversial tracts ('Renversement de la Morale de Jesus Christ par les Calvinistes'; 'L'impiété de la Morale des Calvinistes,' etc.), and with his friend Nicole composed the great work, 'La Perpetuité de la Foi de l'Eglise Catholique touchant l'Euchariste,' in opposition to them. On account of the new persecutions of the court, or rather of the Jesuits, he fled, in 1679, to the Netherlands. He was a man of a vigorous and consistent mind, full of solid knowledge and great thoughts; in his writings, bold and violent to bitterness, undaunted in danger and of irreproachable morals. His works were published at Lausanne between 1775 and 1783, and again at Paris in 1843. There is no modern biography. For his philosophy consult Bouillier, 'Histoire de la philosophie cartésienne' (Paris 1868); and for his mathematical achievements consult Bopp, 'Abhandlungen zur Geschichte der mathematischen Wissenschaften' (Leipzig 1902). (4) JACQUELINE MARIE, sister of the preceding, a French nun better known as Marie Angélique de Sainte Madeleine. She was famed for piety and was prominent among the Jansenists. She was prioress of Port Royal. Consult Life by Martin (1873).

ARNAUT KEUI, koi, a village on the European side of the Bosporus, five miles northeast of Constantinople, of which city it is a suburb. It is built on the site of the Byzantine Michaelion, where stood the more ancient Hestiæ. The name Michaelion was derived from the church erected there to Saint Michael by Constantine and rebuilt by Justinian. It was

broken down by Muhammad II, who used the materials for building the citadel at Rumeli Hissar.

ARNAUTS, är'näts, or **ALBANIANS.** See ALBANIA — HISTORY.

ARNDT, ärnt, **Ernst Moritz,** German poet and patriot: b. Schoritz, on the Island of Rügen (then Swedish territory), 26 Dec. 1769; d. Bonn, 29 Jan. 1860. His father was a prosperous peasant and gave his son a good schooling with the object of training him for the ministry. He finished his studies at Greifswald and Jena, after which, deciding that he did not want to enter the clerical profession, he visited many other countries. In 1806 he was appointed professor of history at Greifswald. Here he wrote 'Der Geist der Zeit' (1807), in which he attacked Napoleon with such boldness that after the battle of Jena he was obliged to flee to Sweden. Three years later he was able to return to his professorial work. In 1812, however, he was again obliged to leave the country and this time, on the invitation of Baron von Stein, he went to Russia. After the defeat of the French in Russia in that same year he returned to Prussia where he continued to advocate German unity. He was in the midst of the agitation that resulted in the War of Liberation which culminated in the battle of Leipzig. His writings, full of energy and fire, roused the German patriots during this period and several poems which he wrote then were put to music and sung by the soldiers; since then several of them have become national songs. Most notable of these, 'Was ist des Deutschen Vaterland?,' is now sung wherever German is spoken. In 1817 he married the sister of Schleiermacher, the great liberal preacher and theologian. The following year he was appointed professor of history in the newly-established University of Bonn, but his liberal views brought him into disfavor with the authorities and two years later he was suspended. The next 20 years of his life was spent in retirement. On the accession of Frederick Wilhelm IV to the throne of Prussia he was, in 1840, restored to his professorship at Bonn. In 1848 he was one of the deputation to offer to the King of Prussia the crown of Imperial Germany. Arndt's fame rests rather on his ability to rouse the fires of enthusiasm in others than on any great talents displayed in his work. He was immensely popular in his time and his popularity was founded on such sincere and true personal qualities that it has never since quite died out. His chief works are 'Märchen und Jugenderinnerungen' (1818); 'Versuch einer Geschichte der Leibeigenschaft in Pommern und Rügen' (1803); 'Deutscher Volkskatechismus' (1812); 'Was bedeutet Landwehr und Landsturm?' (1813); 'Der Rhein, Deutschlands Strom aber nicht Deutschlands Grenze' (1813); 'Erinnerungen aus meinem äussern Leben' (Leipzig 1840). The latter work forms the basis of E. M. Seeley's 'Life and Adventures of E. M. Arndt' (1879). Various biographies have been written, the best being by Schenkel (Elberfeld 1869), Langenberg (Bonn 1869) and Bauer (Hamburg 1882).

ARNDT, or **ARND, Johann,** German Protestant theologian: b. Ballenstedt, Anhalt, 27 Dec. 1555; d. Celle, Hanover, 11 May 1621. After having studied at Wittenberg, Strassburg and Basel, he was made pastor at Badeborn, Anhalt, 1583. This place he filled for seven years, when because of a dispute with Duke John George over procedure in the ritual he was deposed. He was, however, soon able to find another place at Quedlinburg, but here he was so much disliked by the townspeople that in 1599 he left, going then to Brunswick. In 1611 he was appointed general superintendent at Celle, Hanover, where he remained until his death. His chief works are 'True Christianity' (1610); 'Garden of Paradise' (1612). The best English translation of the first is that edited by Charles F. Schaeffer (1868). Of the latter the best English translation is by A. W. Boehm (1716).

ARNDT, Wilhelm, German historian: b. Lobsens, Posen, Prussia, 1838; d. 1895. He was graduated from the University of Göttingen and became connected with the University of Leipzig. For many years he was a collaborator on the 'Monumenta Germaniæ Historica.' His chief works are 'Kleine Denkmäler aus der Merowingerzeit' (1874); 'Schrifttafeln zur Erlernung der lateinischen Paläographie' (1874, 3d ed., 1898).

ARNDTS VON ARNESBERG, Ludwig, German jurist: b. Arnsberg, Prussia, 19 Aug. 1803; d. Vienna, 1 March 1878. He was first appointed professor of jurisprudence at Bonn, then held the same position at Breslau, Munich and finally, in 1855, in Vienna, where he remained until his death. In 1848 he was a member of the National Assembly at Frankfurt where he advocated strongly the right of Austria to enter the German Confederacy. In 1871 he was knighted by the Emperor of Austria. His chief works are 'Lehrbuch der Pandekten' (14th ed., 1899); 'Juristische Encyclopädie und Methodologie' (9th ed., 1895); 'Die Lehre von den Vermächtnissen' (3 vols., 1875); 'Gesammelte zivilistische Schriften' (3 vols., 1874); 'Kritische Uberschan der deutschen Gesetzgebung und Rechtswissenschaft' (in collaboration with Bluntschli and Pözl, 8 vols., 1854).

ARNE, ärn, **Thomas Augustine,** English composer: b. London, 12 March 1710; d. 5 March 1778. His father, a prosperous tradesman, sent him to Eton, then to law school. But even while studying law Arne devoted most of his leisure to music, becoming an accomplished violinist. Finally, however, he decided to abandon the legal profession in favor of his music. His first notable composition was the opera 'Rosamond,' which was produced with great success in 1733. His next work, which was even a greater success, displaying a more fluent technique, was the comic opera, 'Tom Thumb, or the Opera of Operas,' which was produced, together with 'Comus,' in 1738. His success encouraged his sister to cultivate her voice and she afterward became a famous singer under the name Mrs. Cibber. In 1736 he married a popular singer, Cecilia Young. With her he made a very successful two years' tour of Ireland after which, in 1745, he became composer for the Drury Lane Theatre. "Rule Britannia" (q.v.), the British national air, is his composition.

In 1762 he produced 'Artaxerxes,' an opera in the Italian style, but his talents were not adapted to dramatic effects in music. His most successful pieces were simple melodies and glee songs. The music to Garrick's 'Ode to Shakespeare,' played in 1760 for the jubilee at Stratford-on-the-Avon, was by him. Consult Horner, 'Life and Works of Dr. Arne' (London 1893).

ARNETH, Alfred, Ritter Von, Austrian historian: b. Vienna, 10 July 1819; d. there, 30 July 1897. From 1848–49 he represented the district of Neuenkirchen at the Frankfort Parliament; in 1861 was elected to the Diet of Lower Austria; in 1868 was made director of the state archives and president of the Academy of Sciences (1879). His chief works are 'Prinz Eugen von Savoyen' (3 vols., 1864); 'Geschichte der Maria Theresia' (10 vols., 1863–79); 'Korrespondenzen von Maria Theresia,' of Marie Antoinette, Joseph II, Leopold II, Katharina von Russland, etc.; 'Graf Cobenzl und seine Memoiren' (1885); 'Anton, Ritter von Schmerling' (1895); 'Aus meinem Leben' (2 vols., 1893).

ARNHEM, or **ARNHEIM,** Holland, town in the province of Gelderland, on the right bank of the Rhine, 35 miles southeast of Utrecht. It was once fortified but the fortifications have been converted into public walks. The environs of Arnhem being more agreeable than those of almost any other town in Holland, it is much frequented by summer visitors. Among the chief buildings may be mentioned the Groote Kerk, or high church, containing the fine monument of Charles, Duke of Egmont; the Prinzenhof, the town-house and the barracks. Its manufactures consist of cabinet wares, mirrors, carriages, mathematical and physical instruments, etc., and there are numerous paper-mills in the neighborhood. Its trade partly direct in grain and partly transit to Amsterdam, Rotterdam, etc., is important. In the Middle Ages it was a member of the Hanseatic League. It was taken by the French in 1672. In 1795 it was again stormed by the French who were driven from it by the Prussians in 1813. Pop. (1910) 65,685.

ARNICA, genus of plants belonging to the natural order *Compositæ,* and containing 18 species, mostly northwest American. The most important species is *arnica montana,* a perennial herb found in upland meadows in western and central Europe but not extending to Britain. It yields an essential oil in small quantity and a resinous matter called arnicin, $C_{15}H_{22}O_2$, a yellow crystalline substance with an acrid taste. The tincture prepared from it is an old remedy which has a popular reputation in the treatment of bruises and sprains.

ARNIM, är'nĭm, **Elisabeth von,** more generally known as BETTINA, German writer, sister of Clemens Brentano and wife of Ludwig Achim von Arnim: b. Frankfort-on-the-Main, 4 April 1785; d. Berlin, 20 Jan. 1859. Even during her girlhood, most of which was spent in a convent, she showed signs of that eccentricity which characterizes her work. She is more generally known, however, on account of her relations with Goethe and the publication of her correspondence with him in the form of a book entitled 'Goethes Briefwechsel mit einem Kinde' (1835). This work, though for long accepted as genuine, proved largely fictitious. Genuine sonnets by Goethe quoted in it were not addressed to her, but to Minna Herzlieb. In some of her other works, as in 'Dies Buch gehört dem König' (1843), and its sequel, 'Gespräche mit Dämonen' (1852), she attempts to expound certain sociological and political theories of her own. Her supposed correspondence with Goethe was translated into English by herself. Her other works are 'Die Günderode' (1840); 'Klemens Brentanos Frühlingskranz' (1844); 'Ilius Pamphilius und die Ambrosia' (1848). Her collected works were published in Berlin (11 vols., 1853). Her youngest daughter married Herman Grimm. (See DES KNABEN WUNDERHORN). Consult Dege, M., 'Bettina von Arnim' (Kiel 1904); Oehlke, W., 'Bettina von Arnims Briefromane' (Berlin 1904).

ARNIM, Harry Karl Kurt Eduard Von, German diplomatist: b. Pomerania, 3 Oct. 1824; d. Vienna, 19 May 1881. In 1864 he was appointed Prussian envoy at the Papal court. In 1869 he proposed that the governments should appoint representatives to be present at the Vatican Council, a suggestion which was rejected by Bismarck. After the recall of the French troops from Rome he attempted unsuccessfully to mediate between the Pope and the Italian government. In 1871 he was appointed German commissioner to arrange the final treaty with France, a task which he carried out with such success that he was appointed German envoy at Paris and in 1872 became Ambassador. Differences soon arose between him and Bismarck, but the latter was unable to recall him because of the great influence which he enjoyed at court and the confidence which the Emperor reposed in him. By the Conservatives he was regarded as Bismarck's successor. In 1874 he was recalled from Paris and soon after was arrested on the charge of embezzling state papers. He was condemned to three months' imprisonment, which he avoided by leaving the country. In 1875 at Zürich he published a pamphlet in which he attempted to show that the attack on him was caused by Bismarck's personal jealousy. He made repeated attempts to be allowed to return to Germany; his request had just been granted when he died.

ARNIM, Ludwig Achim von, German poet and novelist: b. Berlin, 26 Jan. 1781; d. Wiepersdorf, 21 Jan. 1831. He studied at Göttingen, being especially interested in the natural sciences. He first attained popularity by writing, in collaboration with Clemens Brentano, a collection of old German folk songs under the title 'Des Knaben Wunderhorn' (1808–19). In 1811 he married Brentano's sister, Elisabeth, who herself gained some popularity as a writer (see ARNIM, ELISABETH VON). His novels are characterized by a fantastic imagination of great originality especially marked in 'Theorie der elektrischen Erscheinungen' (Halle 1799) and 'Hollins Liebeleben' (1802). His other works are 'Ariels Offenbarungen' (1804); 'Der Wintergarten' (1809); 'Die Gräfin Dolores' (1810); 'Halle und Jerusalem' (1811);

'Isabelle von Ägypten' (1811); 'Die Kronenwächter' (1817). His works were collected and published with an introduction by Wilhelm Grimm (20 vols., 1839–48). Consult Hartmann, M., 'L. von Arnim als Dramatiker' (Breslau 1910).

ARNIM-BOYTZENBURG, Hans Georg Von, German general and diplomatist: b. Boytzenburg 1581: d. Dresden 1641. He took part in the Russian War on the side of Gustavus Adolphus and afterward fought with Poland against the Turks. He is chiefly known through his attachment for Wallenstein, by whom he was induced in 1626 to join the imperial forces in spite of his Protestant convictions. He rose rapidly to the rank of field marshal. When Wallenstein was dismissed and German Protestantism was tottering he quit the imperial service for that of the Elector of Saxony. He fought on the side of the Swedes at Breitenfeld (1631), at the head of the Saxon army, and was active in forming an alliance of these two powers in the cause of their common religion. The reappearance of Wallenstein caused him to hesitate and open negotiations, without concealing his plans from Gustavus. After the death of that King he renewed overtures to Wallenstein. But on the assassination of his former commander he began active operations once more. He won an important victory at Liegnitz in 1634, but became more estranged from the Swedes. The peace of Prague witnessed his withdrawal from active life. In 1638 he was imprisoned in Stockholm by the Swedes, but having made his escape, he returned to Saxony and died in the midst of plans to raise an army to liberate German soil from foreign armies. Consult Helbig, K. G., 'Wallenstein und Arnim' (1850) and 'Der Prage Friede' (in Raumer's 'Historisches Taschenbuch,' 1858); Kirchner, E. D. M., 'Das Schloss Boytzenburg' (1860); 'Archiv für die sächsiche Geschichte' (Vol. VIII, 1870).

ARNO (anciently *Arnus*), one of the largest rivers of Italy. It divides Tuscany into two parts and rises in the Apennines on the east of Florence on the border of Romagna, 15 miles west of the sources of the Tiber. It then turns southward toward Arezzo, after which it runs westward through Florence and enters the Mediterranean four miles below Pisa. In ancient times Pisa was situated at the mouth of the river. Near Arezzo the Arno is connected with the Tiber through the canalized portion of its tributary, the Chiana. It is navigable for barges as far as Florence. In many places its banks are protected by dykes because of the frequent rises to which it is subject. From any hill in the neighborhood of Florence the view into the valley of the Arno is charming. The entire course of the river is about 140 miles.

ARNOBIUS (called "Afer," sometimes "the Elder"), a teacher of rhetoric: b. Numidia, Africa; flourished about 300 A.D. At first he was a fierce opponent of Christianity; but he was converted and wrote seven books, 'Adversus Nationes' (or Gentes), in which he seeks to refute the charge of his contemporaries that Christianity was the cause of all misery in the world. To this point he devotes books I and II. The other books are a polemic against heathenism, showing in III, IV and V the folly and immorality of the polytheistic mythology; while VI and VII speak of the heathen temple and sacrificial service. When the work was composed cannot be stated exactly, but probably it was after 303. Arnobius was neither a clear thinker nor a skillful writer. The work lacks a comprehensive knowledge of the Scripture and is influenced greatly by Lucretius and Plato. Greek mythology he knew only from the 'Protrepticus' of Clement of Alexandria, and Roman mythology from the writings of Cornelius Labeo. His naive modalism is merely the expression of a very superstitious sentiment, and his notions concerning the origin, nature and continuance of the soul have anything but a Christian-ecclesiastical color. He is, on the whole, a tedious author. The work was edited by Migne in 'Patrologia Latina' (Vol. XIV, p. 399); by Reifferscheid in the 'Vienna Corpus Scripti Ecclesiastici Latini' (1875, English translation with bibliography in 'Ante-Nicene Fathers,' Vol. VI, 1887). Consult Moule, H. C. G., in 'Dictionary Christian Biography' (Vol. I); Herzog-Hauck, 'Realencyklopädie'; Kruger, G., 'Early Christian Literature' (with bibliography, p. 304); Spindler, 'De Arnobii genere dicendi' (Strassburg 1901); Scharnagl, 'De Arnobii majoris latinitate' (Görz 1894–95).

ARNOBIUS THE YOUNGER, Christian priest or bishop in Gaul, who flourished about 460 A.D. He is the reputed author of certain writings, concerning which scholars are not agreed, except that they belong to the 5th century. They include 'Commentarii in psalmos,' which are usually thought to be the work of a semi-Pelagian Gaul, though they may have been written in Rome; 'Adnotationes ad quædam evangeliorum loca,' which seems to have been used in the supposed gospel-commentary of Theophilus of Antioch; and 'Arnobii catholici et Serapionis conflictus de Deo trino et uno.' The so-called 'Prædestinatus' may have been the work of this mysterious Arnobius. His works are published in Migne, 'Patrologia Latina.' Consult Zahn, 'Forschungen zur Geschichte des Kanons' (Vol. II, pp. 104–19); Baümer, S. (in 'Der Katholik,' Vol. II, pp. 398–406, 1887).

ARNOLD, Abraham Kerns, American soldier: b. Bedford, Pa., 24 March 1837; d. 1901. He was educated at West Point, and commissioned 1st lieutenant, Fifth Cavalry, 17 July 1862. He was brevetted captain for gallant and meritorious service in the battle of Gaines' Mill, Va., and major for similar service at the battle of Todd's Tavern, Va. He received a congressional medal of honor for gallantry in action at Davenport Bridge, Va., 18 May 1864. He commanded the field operations in southeastern Arizona against the Apaches in 1879, and against the Crows in 1887. During the Spanish-American War he commanded the 2d Division of the 7th Army Corps in Cuba. He wrote 'Notes on Horses for Cavalry Service' (1869).

ARNOLD, Sir Arthur, an English statesman and author: b. 1833; d. 1902. He acted as assistant commissioner to administer the public works acts during the cotton famine, 1863–66, and afterward wrote 'The History of the Cotton Famine.' Other literary productions have

been 'From the Levant' (1868); 'Through Persia by Caravan'; 'Social Politics'; and 'Free Land.' He sat in Parliament as a Liberal member for Salford, 1880–85. Established and was president of the Free Land League from 1885 to 1895; was chairman London county council, 1895–96, and was knighted in June 1895. He was a brother of Sir Edwin Arnold (q.v.).

ARNOLD, Benedict, a colonial governor of Rhode Island: b. England, 21 Dec. 1615; d. 20 June 1678. He was a leader of the opposition to Samuel Gorton's settlement at Pawtuxet, 1641. His knowledge of Indian languages enabled him to effect important negotiations with the Indians in 1645. In May 1657 Arnold succeeded Roger Williams as president of the colony, and upon the granting of the royal charter to the colony in 1663 was made the first governor, being re-elected in 1664, 1669, 1677, 1678. He took an active part in the reconciliation and union of the two colonies of Rhode Island and the Providence plantations. The famous windmill at Newport, whose erection was long ascribed to the Northmen, appears to have been built by him.

ARNOLD, Benedict, American general, commonly known as "The Traitor": b. Norwich, Conn., 14 Jan. 1741; d. London, Eng., 14 June 1801. He descended from a leading Rhode Island family; was fairly educated. He was early noted for athletic prowess, reckless daring and resource, and as a man displayed a proud, passionate, uncontrolled nature, quickly responding to affection or resentment. He became a druggist and bookseller in New Haven at 21; prospered, and embarked in the West India trade. At the news of the battle of Lexington he armed a body of 60 volunteers, marched to Cambridge and proposed the capture of Ticonderoga and Crown Point. The Massachusetts Provincial Congress gave him supplies therefor, a commission as colonel and authority to raise troops; but finding at his recruiting ground that an expedition had already started, he hastened after it and claimed command under his commission. As the commander was Ethan Allen, both Allen and the troops declined to pay any attention to it; and Arnold under protest accompanied it as a volunteer and entered Ticonderoga beside Allen. Four days later he was joined by a band of his own, and at once sailed down Lake Champlain and captured Saint John's.

Refused the command of the captured forts, he returned to Cambridge, proposed to Washington an expedition against Quebec, and on 11 September left for the Kennebec with 1,100 men, to cross the divide between its headwaters and the early Chaudière. After a fearful march through sleet storms, frozen lakes, rapids and forests, he reached Quebec 13 November, scaled the heights to the Plains of Abraham and dared the garrison of thrice his numbers to come out and fight. They refused, and reinforcements from Sir Guy Carleton compelled him to fall back. On the arrival of Montgomery the two undertook an assault (31 December) in which the latter was killed and Arnold's leg shattered, but he still blockaded the place till relieved by Wooster in April. Meantime he had been commissioned brigadier-general and given command of Montreal. On the expulsion of the United States troops from Canada, the British planned an invasion by way of Lake Champlain, and Arnold went to Ticonderoga and spent the summer building a fleet to bar their way. On 11 October he fought one of the most obstinate and heroic naval battles in our history, near Valcour Island off Plattsburg. Hopelessly outnumbered, he nevertheless escaped with the most of his boats and all of his men. The British retired to Montreal, and the Americans sent Washington the 3,000 men which enabled the battles of Trenton and Princeton to be fought.

One of Allen's men, whose promotion had been opposed by Arnold on the ground that he had plundered officers' baggage in Canada, brought counter-charges of malfeasance against him in December, which the board of war pronounced "cruel and groundless." But Congress in making five new major-generals, 19 Feb. 1777 passed over Arnold, the senior brigadier, on the ground that Connecticut had two already, and appointed Stirling, Mifflin, St. Clair, Stephen and Lincoln, all of whom together had not a tithe of Arnold's abilities or achievements. He had a right to be enraged; but he contented himself with asking to be made ranking officer as before; offered to serve under his juniors for the present; and in Tryon's invasion of Connecticut in April, did such splendid deeds that Congress for very shame gave him the major-generalship, but still left him at the foot. Meantime he was in pressing need of having his claims against Congress settled. Pay and supplies were hard to extract from that body, and Arnold, in his Canadian expedition and elsewhere, had used his own money freely and pledged his credit repeatedly to keep the movements from utter collapse for lack of them. But the claims were large, Congress was suspicious and dilatory, Arnold's business was half ruined and he needed the money. He was at Philadelphia, seeking restoration of his rank, and, his patience exhausted at the refusal of Congress to act in his behalf, had asked permission to resign, when Burgoyne's invasion of 1777 loomed up imminent, and Washington wrote urgent and repeated requests to Congress to send Arnold north to oppose him. Soothed by this flattering request, he withdrew his resignation and hastened north. In this crisis, it is to him that the country owed its salvation. By a decoy messenger he scattered St. Leger's army in a panic, its Indian allies turning against it and butchering the whites as they retreated. He then foiled Burgoyne's flanking attempt at Freeman's farm 19 September, unsupported by Gates, and in the final battle of 7 October, took command without official right and routed Burgoyne's army. This victory gained for the United States the French alliance, and ultimately the surrender at Yorktown. During the engagement Arnold's leg was shattered and he remained in Albany disabled till spring. On 20 Jan. 1778, Congress restored him his senior rank.

In June he was given command of Philadelphia, where he became engaged to a beautiful girl of a loyalist family, Margaret Shippen. The testimony is conclusive that she had nothing to do with his fall; but her family and the always powerful loyalist society of Philadelphia had for the next two years a great influence over him. The prospects of the United

States grew so bad that even Washington well-nigh lost all hope; the English government offered such seductive proposals that many patriotic citizens considered it wanton wickedness to prolong bloodshed and misery, when all that the war was waged to obtain was offered with fair guarantees. Congress was so faction-ridden and incompetent that many more thought the future of independence most calamitous even if it could be obtained; the soldiers were unpaid and unclothed, deserting fast and nearing a dangerous mutiny which soon broke out. In this state of things, every influential officer at odds with Congress was besieged with expressions of loyalist opinion, and Arnold was in the thick of all that could shake his resolution. As always, he lived beyond his means, and as always he was in bitter feud with the other powers. He had determined to retire and settle on a New York land grant, when he was assailed with a series of charges by the State authorities, headed by Joseph Reed, president of the executive council. Most of the charges were frivolous, but two — that he courted the loyalists at the expense of the patriots, and that he had used his position to make illegal purchases — were serious. A committee of Congress acquitted him absolutely except on two foolish counts, and advised ignoring them. Arnold was satisfied and resigned his command. Reed protested on the ground that he had more evidence, a fresh committee referred the charges to a court-martial, and Arnold spent month after month urging a speedy trial. Reed with equal pertinacity delayed his "evidence" till more than a year after the first indictment; the court-martial returned its verdict 26 Jan. 1780. The court returned the same verdict as the committee, but recommended that Arnold be reprimanded for two frivolous counts, and Washington was compelled to discharge this odious office. He did it in the mildest of terms, however, and offered Arnold the post of honor in the next campaign.

But it was too late; the public disgrace imposed on Arnold after his magnificent services, wounds and losses filled him with determination for revenge, justified to himself by the reasons above stated. Inviting examples were put before him: chiefly of Monk, who had restored Charles II and been rewarded by honors and gratitude; more pertinently, of Marlborough's betrayal of James II by taking his whole army over to William; and others. He really seems to have argued himself into believing that he should be playing the part of a patriot by ending the war at a blow, restoring peace and prosperity, giving the colonies a much better government than they had now or before the war, and practically secure independence under the English offers; and that this once done, all parties would thank and honor him, as he could control negotiations with the English government. This decisive blow would be the putting of the English in control of the Hudson, gaining at a stroke the object of Burgoyne's and other campaigns,— severing the New England colonies from the rest and giving the enemy New York, the central colony. For this end he asked of Washington the command of West Point, the key of the Hudson, with its mass of military stores; the colonies could hardly hold out after such a loss, aside from the strategic gain. He pleaded ill health for asking this instead of the proffered command; and Washington accorded it to him. After the capture of André he escaped to the Vulture, and issued a proclamation justifying himself and asking his countrymen to do likewise, making glowing offers to deserters. The British made him a brigadier-general, and on 20 December he sailed for the James River, where he burned Richmond, entrenched himself for the winter at Portsmouth and in June 1781, returned to New York. In September he was ordered to raid New London, Conn., 14 miles from his birthplace. He burned a quantity of shipping and stores, which set fire to and partially destroyed the town; and the "massacre" of Fort Griswold was achieved by a detachment on the other side of the river Thames.

Shortly after the surrender of Cornwallis in October, he was sent to London to confer with the ministry on the further conduct of the war. The King and the court received him well; but the Liberals denounced him as bitterly as the Americans, and a large share even of the Tories distrusted a renegade and detested a betrayer of his trust. The officers in the British army despised a colonial as heartily as in Braddock's days, and therefore it was found impossible to give him the employment in the army he eagerly coveted. In 1787 he removed to New Brunswick and engaged in the West India trade, with two sons; but in 1791 he returned to London. The next year he fought a bloodless duel with the Earl of Lauderdale, for a stinging insult of the latter in debate in the House of Lords. In 1794 he went to the West Indies to settle, but the Anglo-French wars made it impossible, and he was twice extricated from great personal danger by his alert resource. He rendered great service to the British commanders and in 1795 was thanked by the committee of West India planters, with the wish that he might remain in public service. He also formulated plans for the British capture of the Spanish West Indies; and in 1798 asked for military service, but his request was not granted, even after personal solicitation. The refusal helped greatly to break him down; his unthrifty habits had drained his purse and he had intense pecuniary embarrassments. He was active in fitting out privateers, a speculation which gave him more anxiety than profit; and he died at 60, a worn-out, harassed, unhappy man, seeing that his crime was also a colossal blunder. But that he had first saved the country he tried to ruin, that he was grossly wronged and greatly tempted on his best as well as on his worst side, and that he deserves far more pity than hate, cannot be doubted. Consult 'Lives' by Sparks (Boston 1838); I. N. Arnold (Chicago 1880); Todd (New York 1903).

ARNOLD, Bion Joseph, American electrical engineer: b. Casnovia, Mich., 14 Aug. 1861. After graduating from Hillsdale College, in 1881, he studied at Cornell and the University of Nebraska. He then became an independent consulting engineer, and as such became widely known as a traction expert. In this capacity he was connected with the building of the New York subway, the rebuilding of the Chicago street railway system and the electrification of the New York Central lines. He was one of the first to introduce the use of alternating current and single phase traction

systems, and he was the inventor of a great number of devices for use on electric railways. In 1903 he became president of the American Institute of Electrical Engineers.

ARNOLD, Sir Edwin, English poet and journalist: b. Gravesend, 10 June 1832; d. 24 March 1904. He graduated from Oxford in 1854; taught for a while in Birmingham; and became principal of the Sanskrit College at Poona, near Bombay, where he rendered important service to the government during the mutiny in India. Returning to London in 1861, he joined the editorial staff of the *Daily Telegraph*. In 1888 he was made K. C. S. I. After 28 years of successful newspaper work, he began in 1889 a series of rambles in the East, of which he has left vivid and picturesque accounts in his books of travel. He frequently visited Japan and was attracted by the social and artistic side of Japanese life. He twice visited the United States on lecture tours. Of his original poetry, inspired by Oriental themes and legends, the most famous work is 'The Light of Asia, a Poetic Presentation of the Life and Teaching of Gautama' (1876). 'Indian Idylls' (1883); 'Pearls of the Faith'; 'Sa'di in the Garden'; 'The Light of the World'; 'Potiphar's Wife'; 'India Revisited'; 'Japonica', and 'The Tenth Muse and Other Poems'; 'East and West' (1896); 'The Voyage of Ithobal' (1901), are among his many works. The popularity gained by 'The Light of Asia' was not sustained by the appearance of his later poetical works. See Light of Asia, The.

ARNOLD, Edwin Lester, English author, son of Sir Edwin Arnold. He has written 'A Summer Holiday in Scandinavia' (1877); 'On the Indian Hills' (1881); 'Bird Life in England' (1887); 'England as She Seems' (1888); the novels 'Phra the Phœnician' (1890), and 'The Story of Ulla' (1895); 'Lepidus, the Centurion,' etc.

ARNOLD, George, American poet: b. New York city, 24 June 1834; d. New Jersey, 3 Nov. 1865. As a child he showed a talent for drawing and for some time studied with a portrait painter in New York. He soon abandoned this career and adopting literature as a profession he contributed prose and verse to *Vanity Fair, The Leader* and other periodicals of his day. The "Macarone" papers established his reputation as a humorist, and the 'Jolly Old Pedagogue' is his best known poem. During the Civil War he did military duty at one of the forts on Staten Island. His published volumes are 'Drift: a Seashore Idyl' (1866); 'Poems, Grave and Gay' (1867); 'Poems' (ed. with a biographical sketch by Wm. Winter, Boston 1870; new ed., 1889).

ARNOLD, Isaac Newton, American lawyer and author: b. Hartwick, Otsego County, N. Y., 30 Nov. 1815; d. Chicago, 24 April 1884. Admitted to the bar in 1835, he removed in 1836 to Chicago, where he resided the remainder of his life, engaged in legal practice and taking an active part in politics. From 1861 to 1865 he was a member of Congress, and had a prominent share in measures leading to the abolition of slavery. His ablest speech was on the confiscation bill, 2 May 1862. Upon his retirement from Congress President Johnson appointed him an auditor of the United States treasury. A lifelong friend and intimate of Lincoln, he wrote 'History of Abraham Lincoln and the Overthrow of Slavery' (1867; new ed., 1885). His 'Life of Benedict Arnold; His Patriotism and His Treason' (1870) is in the nature of an apologia. 'Recollections of the Early Chicago and Illinois Bar' appeared in 1880. Consult Washburne, E. B., 'Isaac Newton Arnold,' an address delivered before the Chicago Historical Society of which Arnold was president for several years (Chicago 1884).

ARNOLD, Johann Georg Daniel, Alsatian dialect poet and jurist: b. Strassburg, 18 Feb. 1780; d. there, 18 Feb. 1829. He was educated in his native city, at Göttingen and at Paris. In 1806–09 he was instructor in French civil law in the Coblenz Law School and in the latter year became professor of history at Strassburg and of Roman law after 1811. His lyrics (in High German) are meritorious, but he is at his best in 'Pentecost Monday' (1816), a comedy in Strassburg dialect and rhymed Alexandrine verse, pronounced by Goethe "an incomparable monument of ancient Strassburg custom and language, a work which in clearness and completeness of intuition and ingenious delineation of detail can scarcely be equalled." He wrote a notable legal work entitled "Elementa Juris Civilis Justinianei cum Codice Napoleoneo et Reliquis Legum Codicibus Collata' (1812).

ARNOLD, Matthew, English poet, essayist and critic: b. Laleham, 24 Dec. 1822; d. Liverpool, 15 April 1888. The eldest son of Thomas Arnold (q.v.), the historian and headmaster of Rugby, he was taught at Laleham by a clerical uncle, and, after a short period at another school, was transferred to Rugby in 1837. Here he won a prize for a Byronic poem, 'Alaric in Rome' (1840). In 1841 he entered Balliol College, Oxford, and in 1843 he took the Newdigate prize with a poem on Cromwell, which sold remarkably well. He graduated the next year, and in 1845 was elected to a fellowship at Oriel. After teaching a little at Rugby he became private secretary to the Marquis of Lansdowne, who had charge of the administration of public instruction (1847). In 1849 he published over the initial "A," a small volume entitled 'The Strayed Reveller, and Other Poems,' which he withdrew from circulation before many copies had been sold. In 1851 he was appointed an inspector of schools, a laborious post which he held for over 30 years.

In 1852 he issued his second collection of verse, 'Empedocles on Etna, and Other Poems,' of which the semi-dramatic title-piece and 'Tristram and Iseult' were the chief features. There were also some excellent lyrics, but the volume, though full of promise, was somewhat too academic to command attention, and Arnold soon withdrew it. In 1853 he made a fresh attempt with 'Poems by Matthew Arnold, a New Edition,' which included the best pieces of his former volumes, except 'Empedocles on Etna,' and gave for the first time two of the finest of his ambitious poems, 'Sohrab and Rustum,' and 'The Scholar Gipsy.' To this volume, which went through three editions in four years, he prefixed as a preface a plea for the establishment of a more classical and simple taste in poetry. This was important because it laid down the main critical principles Arnold was

himself to follow, and indicated the lines of his subsequent opposition to many English habits and beliefs.

In 1855 he published a second series of his poems mainly consisting of previously issued pieces omitted from the volume of 1853, but presenting also an important new narrative poem drawn from Scandinavian mythology, 'Balder Dead.' His poetical work had now attracted enough notice to secure his election, in May 1857, as professor of poetry at Oxford. After one term of five years he was re-elected.

His 10 years of lecturing naturally did much to formulate his critical principles. In 1861 he published three lectures 'On Translating Homer,' and the next year added 'On Translating Homer: Last Words.' The volumes displayed the blended strength and weakness that were to mark his critical work as a whole. Their style was admirably simple and polished, but was marred by too frequent repetition of phrases and over-emphasis upon favorite ideas. The matter was sound, original, brilliant; yet the lecturer devoted too much attention to the errors of individual translators and displayed a too manifest enjoyment of his own cleverness, which involved a jaunty disregard for the feelings of others. Arnold had a native gift for apprehending and expounding the essential principles underlying the various forms of literature that appeal widely and deeply through a long period of time. In other words, he was born to comprehend and love and interpret works of classical quality — particularly great poetry. With works of more individual quality, with much of mediæval and romantic literature, with the lighter varieties of verse and prose, and with not a little of the work of his contemporaries he was scarcely sure in his critical touch. He was not altogether catholic in his tastes and applied his formulas too rigorously, as when he underrated Shelley's poetry largely because it did not furnish such «a criticism of life» as could be found in the verse of his own favorite, Wordsworth. Then again, Arnold tended to forget that too great insistence upon one's own ideas and bantering sarcasm toward one's opponents are often fatal to success as an advocate, and, despite his striving after disinterestedness, he was a born advocate and controversialist. At bottom, he was true, simple, modest; on the surface he was flippant and dogmatic and rather intolerant. He would discuss charmingly and brilliantly, it is true, such topics as 'The Study of Celtic Literature' (1867), on which he could scarcely speak with authority, and he thus exposed himself to criticism by inferior men who were able to lessen his proper influence on public opinion. In 1865, however, the first series of his 'Essays in Criticism,' with its illuminating, unpedantic discussion of important writers, both classical and modern, placed Arnold above all contemporary English critics and gave his utterances, on literature at least, decided authority and influence. British insularity and superciliousness in literary matters could not be uprooted, but were somewhat pruned. This service makes Arnold a public benefactor, whether or not his indebtedness to Sainte-Beuve, Goethe and Heine prevents our ranking him among the world's most original critics. But he did more than convince some of his countrymen that they should not foster «philistine» and «barbarian» tastes; he gave them sound critical principles, brilliantly phrased, which they could apply not only to their reading, but to their lives.

Meanwhile, he had been performing more overtly practical services, not only in inspecting and commenting on English schools, but in studying and reporting on the educational systems of the Continent. 'Popular Education of France' appeared in 1861; 'A French Eton' in 1864, and 'Schools and Universities of the Continent in 1868.' The next year he published 'Culture and Anarchy' (previously issued in the *Cornhill Magazine*), the most influential of all his attacks upon philistinism, especially in social matters. In his sprightliest book, 'Friendship's Garland' (1871), he carried the war he was waging under the banner of culture, or of «sweetness and light,» more specifically into the domain of politics, where his success was less conspicuous, partly on account, it would seem, of a temperamental unfitness to grapple with the practical side of the problems peculiar to the new field. The year before he had made a still more venturesome incursion into the domain of religion and theology. Although a few of the more advanced of his countrymen were prepared to welcome his efforts to popularize the results of German and French investigation of Biblical problems, many of his readers, repelled by his apparent unorthodoxy, denounced him or pitied him for his hostility or disloyalty to religion and the Church, both of which he was, in his own somewhat-detached way, heartily endeavoring to serve. Nevertheless, 'Saint Paul and Protestantism' (1870), 'Literature and Dogma' (1873) — the best of the series — 'God and the Bible' (1875), and 'Last Essays on Church and State' (1877) were serviceable in breaking down prejudices, and, however lacking in permanent value as contributions to literature, were seemingly productive of lasting benefit.

During most of this period of brilliant prose-writing and wearisome school-inspecting Arnold's far from copious spring of poetry almost ran dry. The year after he began his duties as professor of poetry at Oxford he published his experiment in tragedy of the Grecian type — 'Merope' (1858). No reprint of it was needed until 1885. In 1867, the year he was superseded as lecturer at his alma mater, he published a volume of 'New Poems,' in which he made good his claim to rank with Gray as an elegiac poet by his beautiful pastoral elegy 'Thyrsis,' in honor of his friend, the poet with whose name his own is often associated, Arthur Hugh Clough (q.v.), and by the equally beautiful and pathetic, but less complex and academic 'A Southern Night,' in memory of his brother, William Delafield Arnold, director of public instruction in the Punjab. Another elegy of much merit was 'Rugby Chapel,' in memory of his father, written 10 years before in the short rhymeless verses he liked to experiment in. Elegiac also, in the sense that in them he bemoaned the passing of old forms of faith and the misery of buffeted souls like his own, were the nobly beautiful 'Stanzas from the Grande Chartreuse,' another poem that serves to link Arnold's name with that of Gray. In 1869 his poems were collected in two volumes. His work as a poet was now practically over, save for an occasional tribute — such as the stanzas in memory of Dean Stanley and the pathetic

poems on Geist, the dachshund, and other household pets. He had become more and more reflective and, in consequence, more and more prone to select moral and intellectual themes, rather than such as appeal primarily to the simpler emotions and stimulate the creative faculty of the born lyrical or narrative poet. His creative spontaneity declined in equal measure with the increase of his argumentative combativeness and of his absorption in the religious and political problems of the period. For about a quarter of a century, during which his fame spread widely, the public knew him chiefly as a man of letters of great versatility and of acknowledged authority in literary criticism rather than as one of the most highly gifted and original of the Victorian poets. Reprints of his poetry had, however, been welcomed in 1877 and 1885 — not to speak of the selections from his poems made by himself in 1878 — and before he died a grateful though not a wide recognition had been given to this earlier and, in the opinion of some, more beneficent and attractive side of his genius. Much of this admiration had been yielded to him by readers who had found that his poems of religious unrest reflected their own doubts and regrets even better than the similar poems of Clough. Some readers, however, were attracted rather by the clear if cold perfection of his classical poetic style. Since his death the opinion has been quite freely expressed — with more reason, perhaps, by the second of the groups of readers just described — that in a generation or two his fame will rest mainly and securely upon his work in verse.

Despite the drudgery of the post Arnold served as an inspector of schools until 1883, when he was enabled to retire owing to the fact that, much to his surprise, Mr. Gladstone had caused a pension of £250 a year to be conferred upon him. His home had been for some years in London, then in the neighborhood of Harrow, and in 1873 he had settled at Cobham. His domestic life was uneventful and happy, save for the deaths of children and other parental afflictions. During his later years he continued his critical writing in the magazines, gathering his articles into such volumes as 'Mixed Essays' (1879), 'Irish Essays and Others' (1882), and 'Discourses in America' (1885). The last named was composed of the three lectures — 'Numbers; or, The Majority and the Remnant,' 'Literature and Science,' and 'Emerson' — which he delivered during his first visit to the United States, where he had a married daughter living. He came first in 1883 and lectured into the next year; in 1886 he came again. In 1888 a volume of papers 'Civilization in the United States; First and Last Impressions' was published at Boston, but not in England. Besides collecting his essays and lectures, he also edited during this period several volumes of selections from favorite authors — 'A Bible-Reading for Schools,' (1872) — Isaiah, chapters 40-66 — the 'Six Chief Lives' (1878) from Johnson's 'Lives of the Poets,' selections from Wordsworth (1879) and Byron (1881), 'Edmund Burke on Irish Affairs' (1881) and 'Isaiah of Jerusalem' (1883).

When he was at the very height of his fame, he died suddenly of heart-disease at Liverpool, where he had gone to welcome his daughter home from America. He was buried in the churchyard of All Saints at Laleham, his birthplace. See EMPEDOCLES ON ÆTNA.

Bibliography.— The year of his death some of his literary essays, including those on Gray and Keats contributed to Ward's 'English Poets,' were gathered under the title 'Essays in Criticism, Second Series.' The next year his 'Reports on Elementary Schools, 1852-1882' were edited by Sir Francis Sandford. In 1895 two volumes of his letters, scarcely great as literature, but full of intimate and valuable details, were edited by Mr. G. W. E. Russell. His 'Note Books' appeared in 1902. Uniform editions of his writings have been attainable in America for over 20 years, and there are popular one-volume editions of his poems. Three critical biographies, each of brief compass, have been devoted to him — one by Professor Saintsbury (1899, 'Modern English Writers'), one by Mr. Hubert Paul (1902, in the new series of 'English Men of Letters') — neither thoroughly satisfactory — and one by Mr. G. W. E. Russell (1904, 'Literary Lives') — more of a study than a biography on account of Arnold's wish that no formal life of himself should be undertaken. For further criticism consult Stedman, 'Victorian Poets' (1885), Walker, Hugh, 'The Greater Victorian Poets' (1895) and Dawson, W. H., 'Matthew Arnold' (1904), as well as essays by George E. Woodberry ('Warner's Library'), Frederic Harrison ('Tennyson, Ruskin, Mill'), Lewis E. Gates ('Three Studies in Literature'), W. C. Brownell ('Victorian Prose Masters'), T. H. Ward (Ward's 'English Poets,' Vol. IV, enlarged edition), A. Birrell ('Res Judicatæ'), W. N. Guthrie ('Modern Poet Prophets'), W. E. Henley ('Views and Reviews'), Henry James, 'Matthew Arnold's Essays' (Boston 1908), Chapman, 'English Literature' (ib. 1910); Benson, 'Leaves of the Tree' (New York 1911), Leslie Stephen ('Studies of a Biographer,' Vol. II), Richard Garnett ('Essays of an ex-Librarian' and the 'Dictionary of National Biography,' supplement, Vol. III) and the late Sir J. G. Fitch's ('The Arnolds and their Influence on English Education'). There is an excellent bibliography of Arnold's writings by T. B. Smart (1892).

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ARNOLD, Richard, German-American musician: b. Eilenberg, Prussia, 10 Jan. 1845. He came to the United States when a child and here received his early education and first musical training. At the age of four he was able to play simple melodies on the violin, and at the age of 12 he took his place in a full orchestra. In 1864 he supplemented his elementary training with a course in the Conservatory at Leipzig. On returning to America he became a member of the Theodore Thomas orchestra. In 1880 he became the concert master of the New York Philharmonic Society, a position he held continuously until 1909.

ARNOLD, Samuel, English composer: b. London 1740; d. 1802, In 1760 he was appointed a composer at the Covent Garden Theatre, and set to music the 'Maid of the Mill.' He also produced the oratorios of the 'Prodigal Son,' the 'Resurrection,' and others. He was made a doctor of music in 1773, and in

1783 was appointed organist of the chapel royal. He edited the works of Handel, in 36 volumes folio. In 1794 he was made organist at Westminster Abbey. In 1798 he composed his oratorio of 'Elijah.' Various as were his compositions, his inventive talent was but limited. His 'Cathedral Music' was published in 1790.

ARNOLD, Samuel Greene, American historian: b. Providence, R. I., 12 April 1821; d. there, 12 Feb. 1880. He was graduated from Brown University in 1841, and traveled extensively in Europe, South America and the East. He was lieutenant-governor of Rhode Island 1852, 1861–62, and sat for part of a term in the United States Senate 1862–63. He wrote a valuable 'History of Rhode Island and Providence Plantations' (2 vols., 1860), and was for many years president of the Rhode Island Historical Society.

ARNOLD, Sarah Louise, American educator and writer: b. North Abington, Mass., 15 Feb. 1859. She received her technical education as a teacher at the Bridgewater (Mass.) State Normal School, from which she was graduated in 1878. After teaching for some years she became principal of a training school at Saratoga, N. Y., then supervisor of schools in Minneapolis, Minn., later in Boston, Mass., and finally, in 1902, was appointed dean of Simmons College. She has written extensively on educational subjects. Chief among her works are 'Waymarks for Teachers' (1894); a series of readers, 'Stepping Stones to Literature' (1897); 'Reading: How to Teach It' (1899); 'The Mother Tongue' (in collaboration with G. L. Kittredge, 1900); 'Plans for Busy Work' (1901); 'Manual for Teachers' (1913).

ARNOLD, Thomas, English scholar, headmaster of Rugby School and professor of modern history in the University of Oxford: b. Cowes, Isle of Wight, 13 June 1795; d. 12 June 1842. He received the elements of his education at Warminster, and at the age of 12 was removed to the public school at Winchester. Having obtained a scholarship in Corpus Christi College, Oxford, he entered that college in his 16th year, and though naturally of a shy disposition soon became remarked for the boldness and independence of his views, and the ability, firmness and zeal with which he maintained them. In 1815 he was elected Fellow of Oriel College, and both in that year and 1817 obtained the chancellor's prize for Latin and English essays. His views had been early directed to the Church, but some scruples as to signing the articles made him hesitate for a time. At length these scruples gave way before a more careful examination, and he took deacon's orders in 1818. In 1819 he settled at Laleham, near Staines, where he employed himself in preparing young men for the universities, and in 1820 married the sister of one of his earliest school and college friends, Trevenen Penrose. About this time a remarkable change appears to have come over him; his religious views became finally settled and his whole mind appears to have been wound up to a determination to use life diligently and earnestly for the best and holiest purposes. At Laleham he had much leisure, which he employed partly in the cultivation of general literature, and partly in writing articles on Roman history for the 'Encyclopædia Metropolitana' and collecting materials for an edition of Thucydides, whose writings, as well as those of Aristotle, had long been his favorites. In 1828, by the unanimous vote of the trustees, who were told on high authority that "he would change the face of education all through the public schools of England," he was appointed headmaster of Rugby School and devoted himself to his new duties with the greatest ardor. While giving due prominence to the classics he deprived them of their exclusiveness by introducing various other branches into his course, and was particularly careful that the education which he furnished should be in the highest sense moral and Christian. His success was remarkable. Not only did Rugby School become crowded beyond any former precedent, but its pupils on removing to the universities carried off a very large proportion of prizes, and the superiority of Dr. Arnold's system became so generally recognized that it may be justly said to have done much for the general improvement of the public schools of England. In his position as a director of the London University he zealously endeavored to extend the benefits of a literary and scientific education to all classes and creeds without excluding religion; but failing in his efforts to make examination in the Scriptures requisite to obtain a degree, resigned his office. In 1841 he was appointed professor of modern history at Oxford, and delivered his introductory course of lectures with great success. The works by which Dr. Arnold will continue to be best known are his edition of Thucydides, his 'Roman History,' unhappily left unfinished, and his 'Sermons,' most of them prepared for his own chapel at Rugby, and so admirably adapted to the circumstances of the youths who formed the greater part of his audience, that, though written hastily and at broken intervals snatched from other labors, they are justly held to be models in their kind. Consult Stanley, A. P., 'Life and Correspondence of Thomas Arnold' (Boston 1860); Worboise, 'Life of Dr. Thomas Arnold' (London 1859); Fitch, 'Thomas and Matthew Arnold' (New York 1897); Hughes, 'Tom Brown's School Days' (London 1857). Also biographies in German by Wittig (Hanover 1884) and Zinzow (Stettin 1869).

ARNOLD, Thomas, English writer on literature and editor of old texts, son of Dr. Arnold of Rugby, brother of Matthew Arnold and father of Mrs. Humphry Ward: b. Laleham, 30 Nov. 1823; d. 1900. He was educated at Rugby and Oxford, took his degree in 1845 and was appointed colonial school inspector in Tasmania. He became a Roman Catholic in 1856 and was associated with John Henry Newman as professor in the New Catholic University of Dublin. When Newman retired from the presidency of this institution Arnold followed him to the Oratory at Birmingham. He appears to have abandoned Catholicism for a time, becoming lecturer and examiner at Oxford and at the Royal University of Ireland. After his wife's death in 1888 he was again closely associated with Newman. Among his works are 'A Manual of English Literature'; 'Select English Works of Wyclif' (3 vols., 1869); 'Selections from the Specta-

tor'; 'Beowulf' (text, translation, and notes); 'Henry of Huntingdon'; 'Symeon of Durham'; and 'Chronicles of the Abbey of Bury St. Edmunds'; 'Passages in a Wandering Life' (1900), containing much of interest concerning Cardinal Newman and other friends prominent in the Tractarian Movement.

ARNOLD, Thomas Kerchever, English educator: b. Stamford 1800; d. 1853. He was educated at Cambridge University, became an Anglican clergyman and was appointed rector of Lydon, Rutlandshire. He was successively editor of the *Churchman's Quarterly Magazine*, the *Churchman's Monthly Companion* and the *Theological Critic*. He published theological pamphlets and treatises, 'Short Helps to Daily Devotion' (1847) and some volumes of sermons.

ARNOLD, William Rosenzweig, American Orientalist: b. Beirut, Syria, 14 Nov. 1872. In 1892 he graduated from Ohio Wesleyan University, then took a three-years' course at the Union Theological Seminary. The following year he was made curator of the department of antiquities in the Metropolitan Museum of Art in New York city, a position he held for two years, after which he became a lecturer on the Old Testament and professor of the Hebrew language and literature at Andover Theological Seminary. In 1908 he undertook similar work at Harvard. He has written 'Ancient Babylonian Temple Records' (1896); 'The Rhythms of Ancient Hebrews' (1908); 'The Passover Papyrus from Elphantine' (1912).

ARNOLD, Yuri von, Russian composer and writer on musical subjects: b. St Petersburg, 1 Nov. 1811; d. 1898. He studied for two years at Dorpat, then received a commission as a cavalry officer, in which capacity he fought several battles in Poland. After the conclusion of hostilities he became a secret-police officer. Meanwhile he had been devoting himself to a study of music and musical composition and in 1839 he won a prize offered by the St. Petersburg Philharmonic Society. Later he became musical critic on the *Signale* at Leipzig. In 1870 he was appointed professor of vocal music at the Moscow Conservatory. In 1888 he received an appointment at the Moscow University as professor of the history of musical art. His compositions are 'Svyetlana' (cantata 1839); 'The Gypsy: an Overture to Boris Godunov' (opera). Among his contributions to the literature of music are 'Theory of the Ancient Russian Church and Folk Singing' (1888); 'Is it possible in Musical Art to Establish a characteristically National School of Singing, and on what Data must it be based?' (1889).

ARNOLD OF BRESCIA, brĕsh'a (*Arnaldo da Brescia*), Italian religious and political reformer and agitator: b. about 1100; d. 1155. He was one of the disciples of Abelard, and on returning from Paris began to preach in his native city. In this way he stirred up the people against the clergy; and in France, whither he was forced to flee in 1139, he also found numerous adherents, for the immorality and arrogance of the clergy excited much discontent. The flame which he had kindled could not be extinguished by the excommunication pronounced against him and his adherents by Innocent II. He preached his doctrines in safety at Zürich in Switzerland till about 1144, when he appeared at Rome, where his eloquence occasioned among the people great disorder. The furious multitude, whom he himself could no longer restrain, revered him as their father, and even the Senate protected him till Adrian IV, in 1155, laid an interdict upon the city. This subdued the Romans, and Arnold was obliged to flee. He was taken in Campania and executed at Rome and his body burned; his ashes were thrown into the Tiber and his party was suppressed. His followers were known as Arnoldists.

ARNOLD OF WINKELRIED, wĭng'kĕl-rēd, a Swiss hero, who, at the battle of Sempach, in 1386, sacrificed himself to ensure victory to his countrymen. The Austrian knights, dismounted, had formed themselves into a phalanx, which the Swiss vainly strove to pierce, when Arnold, rushing on the spear points of the enemy and burying several in his breast, thus opened a gap in the fence of steel. The Swiss rushed in through the opening and routed the Austrians with great slaughter.

ARNOLDISTS. See ARNOLD OF BRESCIA.

ARNOLFO DI CAMBIO, är-nōl-fō dē käm'byō, also known as ARNOLFO DI LAPO, Italian architect and sculptor: b. Colle, Tuscany, 1232; d. 1302. He was a pupil of Niccola Pisana, the sculptor. He has been considered one of the greatest architects of Florence of the Gothic period and also one of the greatest sculptors of that period. The Church of Santa Croce in Florence is one of his earliest works. In 1296 he was assigned the task of reconstructing the cathedral of Florence. He died before this work was completed, only the first story having been built, and his successor did not follow out his plans.

ARNON, now known as the Wady Mojib, a river emptying into the Dead Sea. It is a short stream not over 13 miles in length, but runs through so rough a country that no one has been able to follow it along its entire course. At both sides rise towering cliffs of limestone and basalt rocks often reaching a sheer height of 1,700 feet. Waterfalls break its course in two places, falling from no great height but so close together are the walls of the deep gorge that the thunder of the falling water reverberates miles away. The Arnon is mentioned in the Bible in several places. In Num. xxi, 14, 15, it is referred to as Moab's frontier supposedly against Sihon's kingdom and his advance to the river is also described in xxi, 28. For description with photographs consult Schmidt, N., 'The River Arnon' (in *The Journal of Biblical Literature*, 1906).

ARNOT, William, clergyman of the Free Church of Scotland: b. Scone, 6 Nov. 1808; d. Edinburgh, 3 June 1875. He was educated at the University of Glasgow. In 1838 he became pastor of Saint Peter's Presbyterian Church, Glasgow. In 1843 he joined the Free Church movement and became pastor of Free Saint Peter's Church, Glasgow. After 20 years' service here he succeeded Professor Rainey as pastor of the Free High Church, Edinburgh, serving it until his death. He came to America three times, once as dele-

gate to the Evangelical Alliance. He was author of the 'Life of James Halley' (1842); 'The Race for Riches' (1851); 'Laws from Heaven for the Life on Earth' (2 vols., 1857–58); 'The Parables of Our Lord' (1864); 'The Life of James Hamilton' (1870).

ARNOTTO, coloring matter obtained from the seed of the *Bixa orellana,* an evergreen plant indigenous to Brazil, Cayenne, and other places. It is used in dyeing and calico printing and as a coloring ingredient in ointments, varnishes and also for butter and cheese. In extracting it the seeds of the fruit capsules are crushed and fermented; they are next rubbed, mashed and the coloring matter washed away. The water is next drawn off and the coloring matter allowed to dry in the shade. It is then broken into cakes and wrapped in leaves. It is insoluble in water but dissolves with a red color in alcohol, fixed oils, etc. It is used as a body-paint by the Indians as a protection against mosquito-bites.

ARNOULD, är'noo, **Sophie,** French actress and singer: b. Paris 1744; d. 1802. She made her début at the Grand Opera, Paris, 15 Dec. 1757 and attained great success. For over 20 years thereafter she was the most prominent singer at the Royal Opera. She created the rôle of Iphigenia in Glück's 'Iphigenia in Aulis.' She was also famed for her beauty and wit and was intimate with Helvetius, D'Alembert, Diderot, Rousseau and other great men of the time. Her epigrams and witticisms were collected and appeared in a volume under the title of 'Arnouldiana.'

ARNPRIOR, Canada, the county-seat of Pembroke, Ontario, situated 37 miles west of Ottawa, on the Canadian P. and Grand Trunk railways, at the junction of the Ottawa and Madawaska rivers. The town is beautifully situated, has excellent water and sewerage systems; has two large saw-mills employing 700 men, sash factories, woolen, knitting and mica factories and a creamery. Pop. (1911) 4,405.

ARNSBERG, ärns'berg, Prussia, capital of an administrative district of the same name, province of Westphalia. It is located on high ground which is swept on three sides by the river Ruhr, overtopped by the ruins of the old castle of the counts of Arnsberg. Its industries consist chiefly of the production of paper, spirits and beer and there is a large railroad repair shop there. Not far distant in the Helve and Möhne valleys is a storage reservoir dam which is one of the largest pieces of engineering work of its kind in Europe. Pop. 10,256.

ARNSTADT, Germany, capital of the principality Schwarzburg-Sondershausen, 12 miles south of Erfurt on the banks of the Gera on the Dietendorf-Ilmenau Railroad. It is an important market for grain and other agricultural products raised in the surrounding country. Its manufacturing industries are textiles, shoes, gloves and beer. There are old copper mines in the neighborhood and salt deposits. Its warm springs have made it an important summer health resort. Among its notable public buildings are an old castle in which is exhibited a valuable porcelain collection. In one of its churches, Saint Boniface, the famous composer, J. S. Bach, was for some years organist. Pop. 17,907.

ARNULF, King of Germany, Roman Emperor, natural son of the East-Frankish King, Karlmann and Liutswinda, sister of the North Gaulish Count Ernert: b. about 850; d. 899. He was elected King of the East Franks, after heading a revolt which deposed Karl the Fat. In 891 he repelled an invasion by the Norsemen and drove them out of his kingdom. Three years later he led an army into Italy where in 896 he had himself crowned emperor.

ARNULF, Saint, bishop of Metz, ancestor of the Carlovingian rulers: b. 582; d. 6 Aug. 641. In 627 he retired from the bishopric and became a hermit in the Vosges. The year after his death his body was brought down into Metz and interred in the church there bearing his name.

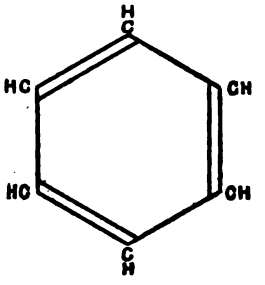
ÁROK-SZALLAS, ŏr-ōk-säl'äsh, or **JASZ-AROK-SZALLAS,** Hungary, privileged market-town, 44 miles northeast of Budapest. It has a large trade in grain. Pop. 12,067.

AROLSEN, ä'rōl-sĕn, Germany, town, capital of the principality of Waldeck, on the river Aar, 21 miles northwest of Cassel. It contains a castle, art gallery, a gymnasium and a parish church and a valuable library. Rauch, the sculptor, and the painters, Wilhelm and Friedrich Kaulbach, were born in Arolsen. Pop. 2,811.

AROMA, Greek term denoting perfume. Many plants yield a more or less delightful odor, often due to volatile oils called essences, which can be separated from them by suitable processes. Sometimes odor proceeds from a substance which cannot be seized and to which the name of *aroma* is more particularly applied. It appears that substances altogether, or almost altogether, inodorous may be made to diffuse a strong odor by the mixture of different substances which facilitate their volatilization. Thus, when musk is dried, ammonia is separated from it and seems to be the vehicle of the odor since the residuum becomes inodorous and yet may again be made as odoriferous as it was at first by impregnating it with a quantity of the substance which had been carried off. Tobacco, in like manner, owes part of its odor to ammoniacal salts mixed with it in the process of manufacture. One singular fact is that many plants of tolerably strong odor yield an inodorous liquid when dissolved in water and yet communicate odor to the oils with which they are macerated. See PERFUMERY.

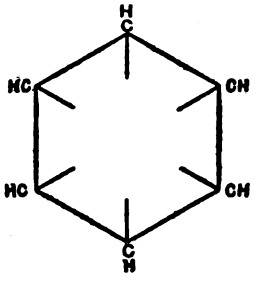
AROMATIC COMPOUNDS, a numerous and exceedingly important class of substances, fundamentally differing from the fatty compounds in constitution, and named from the fact that the earliest known representatives of the class were resins, oils and balsams, distinguished by a marked aromatic odor. The name is now applied to all substances containing a «benzene nucleus» (presently to be described). Benzene itself is the simplest example of an aromatic body. Its formula, expressed in the simplest way, is C_6H_6, but when the attempt was made to represent the composition of benzene by a «structural formula,» numerous diffi-

culties were encountered. For example, benzene behaves like a saturated compound in most respects, yet it contains eight atoms less of hydrogen than the saturated paraffin "hexane" (C_6H_{14}) containing the same number of carbon atoms. Again, any or all of the hydrogen atoms in benzene can be replaced by other monovalent elements (or radicals); and the persistence of the group C_6 in the derivations of benzene, even when all the original hydrogen atoms have been replaced by other elements or radicals, indicates that the carbon atoms in that body are intimately related to one another, in some manner. Furthermore, it has been proved by experiment that the hydrogen atoms in benzene are "of equal value," so that it makes no difference, in forming a substitution compound, which atom of hydrogen is replaced, and this fact indicates that the hydrogen atoms should occur in the

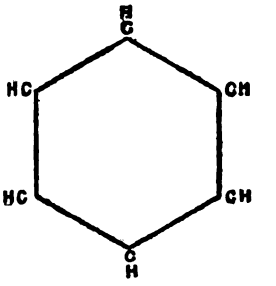


structural formula symmetrically. To reconcile these considerations (and many others) Kekulé, in 1865, proposed for benzene the structural formula preceding.

The symmetry of the body with respect to hydrogen is here evident, and the persistence of the group C_6 is explained by assuming the six carbon atoms to be united to one another in the form of a closed chain, supposed to possess sufficient chemical strength to maintain its own integrity, save under exceptional circumstances. The closed ring of six carbon atoms is the "benzene nucleus," referred to above, which constitutes the distinctive feature of the aromatic compounds as a class. It will be observed that in Kekulé's structural formula the carbon atoms are all tetravalent, just as the carbon is in carbon dioxide (CO_2), and that three of the four valencies of each carbon atom are satisfied by the valencies of other carbon atoms, while the fourth is satisfied, in each case, by a hydrogen atom. Von Baeyer has proposed a slightly different structural formula for benzene, even

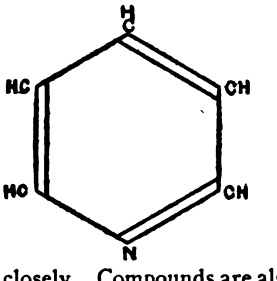


more symmetrical in appearance than Kekulé's, but which raises certain questions that are not yet answered. His formula is as shown herewith. The closed carbon chain is present here also, but only three of the valencies of each carbon atom are definitely provided for, and it is assumed that the six remaining valencies (one to each carbon atom) are satisfied by a



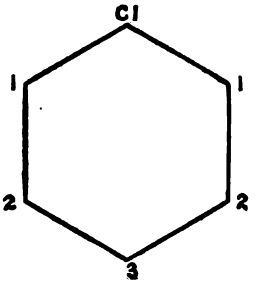
sort of "central linkage," whose precise nature is not determined or defined. It is customary, at the present time, to express the structural formula of benzene in the simple form without attempting any explanation of the fact that the carbon atoms are here apparently trivalent. Much thought has been expended upon this matter, and the constitution of benzene is one of the most interesting problems in the realm of organic chemistry. The structural formulas presented above are not to be taken in any sense as pictorial representations of the actual geometrical configuration of the benzene molecule. We know nothing at all about the shape of a molecule, nor about the way in which its parts are associated with one another, in space. The structural formulas employed in chemistry are mere empirical diagrams, for representing, to the eye, the chemical properties and relations that have been observed in the laboratory.

Compounds have been prepared which contain closed rings of three, four and five atoms of carbon, respectively, but these are not classed as aromatic compounds. They are intermediate, in general properties, between the aromatic series and the fatty series, but resemble the

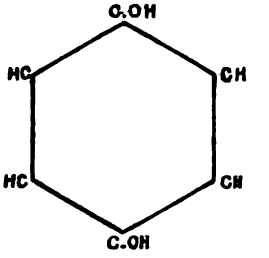


latter more closely. Compounds are also known in which the chain is closed by an atom of oxygen, or of sulphur, or of nitrogen. Thus the structural formula of pyridine is as shown herewith. Such substances could be classed as "aromatic compounds" by an extension of the definition of the aromatic group, but are usually regarded as outside of the limits of that group. The aromatic compounds are so numerous, and include so many substances of technical importance, that only the merest outline of their general character can be given in this place. In general it may be said that they are derived from benzene by replacing one or more of its typical hydrogen atoms by an equal number of monovalent radicals (either simple or compound). The essential features of these substitutions may be illustrated by considering the

chlorobenzenes. By the action of chlorine upon cold benzene, several substitution products are formed, having the formulas C_6H_5Cl, $C_6H_4.Cl_2$, $C_6H_3Cl_3$, etc. according to the number of atoms of hydrogen that are replaced by the chlorine. The first of these substitution products, $C_6H_5.Cl$, is called simply "chlorobenzene," and it is to be noted that since the hydrogen atoms in the original benzene are all "of equal value" (that is, all involved symmetrically), it makes no difference *which* hydrogen atom is replaced by the chlorine; hence only one chlorobenzene having the formula $C_6H_5.Cl$ is possible. But when a *second* atom of hydrogen is replaced by chlorine, the resulting compound, $C_6H_4.Cl_2$ (known as *di*-chlorobenzene), can exist in no less than three distinct isomeric forms, according to the relative positions of the chlorine atoms in the benzene ring. Let the structural formula of chlorobenzene ($C_6H_5.Cl$) be represented by the skeletonized scheme, the numbers representing the several groups of CH, in one of which the hydrogen is to be replaced by a further substitution of chlorine. It is evident that the next chlorine atom may replace a hydrogen atom at any one of the five vertices to which numbers have been attached; but it is also evident from symmetry that the two positions numbered "1" must be considered as essentially identical, as far as the product resulting from a substitution is concerned, and the same is also true of the two positions marked "2." Only three essentially different ways of substituting the second chlorine atom need therefore be considered. When the second chlorine atom is situated at an angle adjacent to the first, the product is known as *ortho*-dichlorobenzene; when the second chlorine atom is separated from the first by one vertex which still retains its hydrogen, the product is known as *meta*-dichlorobenzene; and, finally, when the two substituted atoms of chlorine are *opposite* one another, the product is known as *para*-dichlorobenzene. The three different dichlorobenzenes thus shown by the structural formula to be possible are actually known. All aromatic compounds having the general formula $C_6H_4Y_2$ (where Y is a monovalent element or radical) occur in three isomeric series, just as the chlorobenzenes do, and the separate compounds are distinguished, as already explained in the case of dichlorobenzene, by the prefixes *ortho-*, *meta-* and *para-*. These prefixes are frequently abbreviated to single letters, in works on chemistry. Thus *p*-dihydroxybenzene is often written in the place of the full name, "paradihydroxybenzene."



This particular substance (used in photography and commonly known as "hydroquinone") is formed, as its name implies, by the substitution of two molecules of hydroxyl (HO) for two atoms of hydrogen in the benzene ring, the hydroxyl molecules being opposite each other (as indicated by the prefix *para-*). Its structural formula, therefore, is as below. The



ortho- compound having the same composition (except that its two hydroxyl molecules are in the "ortho" positions), is a different substance, known more familiarly as catechol, or pyrocatechin, and the meta- compound (where the two molecules of hydroxyl are in the "meta" positions) is quite different from either of the others, and is known as resorcinol. The substitutions of monovalent radicals for the hydrogen atoms in benzene are by no means limited to two, nor need the radicals that are substituted be alike. Thus pyrogallic acid, so extensively used as a developer in photography, is obtained from benzene by the substitution of three molecules of hydroxyl for three molecules of the benzene hydrogen; and it therefore has the formula $C_6H_3.(OH)_3$. Vanillin, now largely used in the place of extract of vanilla for flavoring confectionery and ices, is benzene in which three atoms of the original hydrogen have been replaced, respectively, by the groups (CHO), (OCH_3) and (OH). On account of the typographical difficulties involved in printing the structural formulas of the aromatic compounds, chemists often specify the constitution of these compounds by numbering the original hydrogen atoms of the benzene from 1 to 6, and then specifying by number, which hydrogen atom has been replaced by each of the substituted radicals. Thus vanillin (referred to above) consists of benzene in which CHO has been substituted for the first hydrogen atom, OCH_3 for the third, and OH for the fourth: and with this convention the constitution of vanillin may be expressed thus: CHO: OCH_3: OH = 1:3:4.

The existence of tertiary (and higher) substitution products of benzene makes it possible to identify the ortho-, meta- and para- di-substitution compounds, so that the proper designation can be attached to each of them. The dibromobenzenes afford a good example of the way in which this is accomplished. The three essentially different compounds obtained by substituting bromine for two of the hydrogen atoms in benzene are (according to the notation just given) Br: Br = 1: 2, Br: Br = 1: 3, and Br: Br = 1 : 4, these being ortho-dibromobenzene, meta-dibromobenzene and para-dibromobenzene, respectively. Now if an atom of hydrogen in the first of these be replaced by another atom of bromine, it is evident that the new bromine atom may have the position 3, 4, 5 or 6; but the compounds in which the bromine occupies the positions 1 : 2 : 3 and 1 : 2 : 6 must be regarded as identical, as will be seen by constructing the diagram; and, similarly, those in which it occu-

pies the positions 1:2:4 and 1:2:5 must be considered identical. Hence the further introduction of bromine into ortho-dibromobenzene can give rise only to the *two* distinct tri-bromobenzenes 1:2:3 and 1:2:4. If the remaining dibromobenzenes be examined in the same way, it will be found that meta-dibromobenzene can yield (upon further bromination) the *three* distinct tri-bromobenzenes 1:2:3, 1:3:4 and 1:3:3. Finally, it will be found that para-dibromobenzene can yield only *one* tri-bromobenzene; namely, 1:2:4. The identification of a di-substitution bromobenzene as ortho-, meta- or para- is therefore seen to be equivalent to determining how many different tri-bromobenzenes the given di-bromobenzene can yield. This problem has been fully worked out in the case here taken as an illustration, and it has been shown that of the three known di-bromobenzenes, the ortho- compound is the one boiling at 435° F., the meta- compound is the one boiling at 427° F., and the para- compound is the one melting at 180° F. The mode of identification here discussed in detail for bromine substitution products can be applied in other cases also, but the labor involved in the operation is so great that it is usually easier to ascertain the proper prefix for a new di-substitution compound by noting which of the bromo-substitution products must be used as a starting point, in the synthesis of the proposed compound. There is usually but little difference in the boiling points of ortho-, meta- and para-compounds, but the para- compounds have the highest melting points. The benzene ring of ortho- compounds is liable to be broken up by oxidation, while in the other two classes the ring usually persists. The following general law appears to hold true of di-substitution aromatic compounds: When a radical is introduced into a benzene ring in which one hydrogen atom has already been replaced by a radical, the second radical will take a position "meta" to the first one, provided the first was COOH, SO_2H, NO_2, or (probably) CN, CHO or $CO.CH_3$. In most other cases the second radical will mainly take the "para" position, though some of the "ortho" compound is almost invariably produced at the same time. The aromatic bodies include many acids, the simpler of which may be conveniently classified according to the number of molecules of carboxyl (COOH) that they contain, and according to the number of hydrogen atoms that have been displaced in the original benzene ring. The simpler and more familiar aromatic acids mostly contain one carboxyl group, and are therefore said to be "mono-carboxylic." In the mono-carboxylic group, benzoic acid, $C_6H_5.CO\,OH$, is "mono-hydric"; salicylic acid, $C_6H_4OH.COOH$, is "di-hydric"; proto-catechuic acid, $C_6H_3.(OH)_2.COOH$, is "tri-hydric"; and gallic acid, $C_6H_2.(OH)_3.COOH$, is "tetra-hydric." Numerous substances classed by the chemist as alcohols also occur in the aromatic group. The simplest of these (and the only one containing only six atoms of carbon) is phenyl alcohol, which is also known as phenol, and as carbolic acid. This substance is formed when benzene is oxidized by peroxide of hydrogen, in accordance with the equation:

C_6H_6	+	H_2O_2	=	$C_6H_5.OH$	+	H_2O.
Benzene.		Hydrogen peroxide.		Phenyl alcohol.		Water

Phenol is called an alcohol on account of its chemical structure (see ALCOHOL), but it differs widely from the alcohols of the fatty series, since it does not yield an aldehyde, an acid or a ketone, and it is not easily oxidized. Other aromatic alcohols may be prepared by replacing a hydrogen atom in benzene by one of the alcohol radicals (C_nH_{2n+1}) of the fatty series, and then substituting an OH group for one of the hydrogen atoms in the compound so formed. The resulting substance has widely different properties, according to the position of the OH group so introduced. If the OH replaces a hydrogen atom in the alcohol radical, the final compound is called an alcohol; but if it replaces a hydrogen atom in the original benzene ring, the final compound is more accurately classed as a phenol. For example, if CH_3 be substituted for an atom of hydrogen in benzene, toluene ($C_6H_5.CH_3$) is formed. If, now, OH is substituted for a hydrogen atom in the CH_3, the resulting substance, $C_6H_5.CH_2OH$, is known as benzyl alcohol; while if the OH is substituted for an H in the original ring, we have $C_6H_4.(OH).CH_3$, a substance known as cresol, and more properly described as a phenol than as an alcohol. One of the most important members of the aromatic group is amido-benzene, or aniline (q.v.).

A. D. RISTEEN.

AROMATIC VINEGAR, a liquid consisting of strong acetic acid, and obtained by distilling crystallized diacetate of copper. Its aroma is due to the presence of *acetone,* but it is also usually highly flavored with preparations such as cloves, calamus, etc. It has a pleasant perfume, and its vapor, when inhaled, has a powerful effect on the nostrils, and acts as a strong excitant on the whole system. The liquid is highly corrosive.

AROMATICS, plants (sometimes animal and other substances) which have a spicy odor and pungent taste and are used in medicine, cookery, and perfumery. They are largely employed to disguise the taste of drugs, are usually reputed stimulant, anti-spasmodic and, if bitter, tonic and vermifuge; externally they are applied as antiseptics, local anæsthetics and counter-irritants. Their active principles are volatile oils obtained by distillation; but some contain camphor-like substances, such as turpentine; others are bitter like tansy; still others contain an odorous resin, for example, myrrh and benzoin; and lastly there are those with a musky odor, such as the musk plant (q.v.). Among aromatics and the families to which they belong are peppermint, thyme, lavender, of the *Labiatæ* — the whole plant, especially the leaves; caraway, dill, anise, of the *Umbelliferæ* — the seeds or seed capsules; ginger, *Zingiberaceæ* — the root-stocks; cinnamon, cassia, of the *Lauraceæ Myrtaceæ* — the bark; cloves, *Myrtaceæ* — the flower buds; and vanilla, of the *Orchidaceæ* — the fruits. In some cases the aromatic properties are diffused throughout all parts of the plant, but also are often confined to particular organs, such as the root, in ginger; or the bark, in cinnamon; or the flowers, as in cloves; or the fruit, as in vanilla; or the wood, as in aloes-wood.

ARONA, ä-rō'nä, Italy, ancient town near the southern extremity of Lago Maggiore and about 40 miles northwest of Milan. In summer

there is steamer service to Locarno, Switzerland. In the vicinity is the colossal statue of San Carlo Borromeo, 70 feet high, exclusive of the pedestal, 42 feet high. There are silk, cotton and metal works here. Pop. (1911) 6,271.

ARONHOLD, ä'rōn-hōlt, **Siegfried Heinrich,** German mathematician: b. Augerburg, 1819; d. 1884. He was professor of mathematics in the School of Architecture and in the School of Engineering and Artillery in Berlin. The theory of the forms of algebra was developed by Aronhold and the two English mathematicians, Cayley and Sylvester. He was also one of the founders of the mathematical theory of invariants, to which he first contributed the symbolic notation.

AROO. See ARRU ISLANDS.

AROOSTOOK, ą-roos'tǫk, a river in Maine. It rises in Piscataquis County, Me.; flows more than 120 miles in a circular course and enters the Saint John River in New Brunswick. It drains an area about 2,300 square miles and falls 705 feet in its course within the State, and thus affords valuable water power. It was an important factor in the settlement of the long-pending dispute concerning the boundary between the United States and British America.

AROOSTOOK, Lady of The, the title of a book written by W. D. Howells in 1879 — one of the author's early works. The Aroostook is a trading vessel, and the lady of the story is the sole woman passenger in a voyage across the Atlantic. The story is strong and interesting, and contributed greatly to the early reputation of Mr. Howells.

AROUET, a'roo'ā'. See VOLTAIRE.

AROUND THE WORLD IN EIGHTY DAYS, a noted romance by Jules Verne. Phineas Fogg, an English gentleman, wagers that a man can travel around the world in 80 days. He wins his wager after a series of exciting adventures.

AROUND-THE-WORLD RECORDS. Many years have elapsed since Mr. Phineas Fogg, M. Jules Verne's mythical hero, accomplished the supposedly impossible task of circumnavigating the globe in 80 days, a feat which won for him a wager of $100,000 and incidentally a wife. Since that time, however, so many improvements have been made in methods of transportation, so many new routes — like that of the Trans-Siberian Railway (q.v.) — have been completed that Mr. Fogg's once remarkable trip now appears in the light of an extremely commonplace achievement. In fact the person who, to-day, could not travel around the world in less than 80 days would be regarded as a very inexperienced globe-trotter. The first serious attempt to lower Jules Verne's imaginary record was made in 1890, when Miss Nellie Bly, who represented the New York *World,* made the trip around the world against time. She was followed by the late George Francis Train, and both succeeded in accomplishing the tour in less than 70 days. Ten years later Mr. George Griffith, of Chiswick, England, established a new record at 64½ days, but this record stood for less than a year, it having been reduced, in 1901, to 60 days and 13½ hours, by Charles C. Fitzmorris, who made the trip at the request of Hearst's Chicago *American.* The success of Fitzmorris was the means of inspiring many persons to participate in this unique form of record breaking, among the contestants there being several journalists, the representatives of European and Canadian papers. All attempts to lower this last record were unsuccessful, however, until December 1903, when Mr. James Willis Sayre of Seattle, Wash., earned the honor for record breaking by girdling the globe in 54 days, 9 hours and 42 minutes, an achievement that lowered the Fitzmorris record by more than six days and three hours. On 17 July 1911, Andre Jager-Schmidt, a reporter on *Excelsior,* a Paris daily newspaper, left that city under instructions to lower this record. The trip was made without an accident or any unnecessary delay and the traveler arrived in Paris on 26 August, having succeeded in establishing a new record in girdling the earth. M. Jager-Schmidt's official time was 39 days, 19 hours, 43 minutes and 37 4/5 seconds but this time would have been lowered to the extent of a few hours if he had not stopped at Cherbourg to attend a reception.

ARPAD, the conqueror of Hungary, and founder of the Arpad dynasty, which reigned till 1301. He was born in the second half of the 9th century; died in 907. He was the son of Almus, whom the seven Magyar clans dwelling in the steppes northeast of the Caspian Sea had elected their hereditary chief about 889. Thus united into one nation, the Magyars, mustering about 25,000 warriors, crossed the Carpathians and conquered Hungary, when Arpad was elected their prince. Arpad made a raid into Italy about 900 and returned with a large quantity of booty. The first crowned king of the Arpad dynasty was Saint Stephen, who began his reign in 997. This dynasty ended with Andrew III in 1301. Arpad is the national hero of Hungary, and his history is narrated in the oldest chronicles, mixed up with the national legends. His exploits also form the theme of many of the popular songs of the country.

ARPEGGIO, är-pĕd'jō (Italian, from *Arpa,* a harp), in music, the playing of a chord on a keyed or stringed instrument by sounding the notes, not together, but in rapid succession.

ARPINO, är-pē'nō (ancient *Arpinum*), Italy, town in the province of Caserta celebrated as the birthplace of Caius Marius and Cicero. It is situated on a rising ground near the river Garigliano, was originally founded by the Volsci, and became a municipal town under the Romans who took the town in 305 B.C. Its inhabitants became full citizens in 188 B.C. It is still a place of some importance, possesses a royal college called Collegio Tulliano and several churches, and manufactures woolens. Paper, parchment and leather are also manufactured here and marble is quarried near by. Pop. (1911) 10,309. Consult Kelsall, 'Classical Excursion to Arpino' (Geneva 1820).

ARQUEBUS, är'kwę-bŭs, an ancient species of firearm resembling a musket. It was fired from a forked rest, and sometimes cocked by a wheel, and carried a ball that weighed nearly two ounces. A larger kind

used in fortresses carried a heavier shot. See ORDNANCE.

ARRACACHA, ARACACHA, ARRACACIA, ăr-ră-kă'chă, a number of plants belonging to the genus *Arracacia* of the *Umbelliferæ* family, all of which have tuberous roots, which are used by the natives of the uplands of Venezuela, Colombia, Bolivia, Peru and Chile as a food. They boil the arracacha and use it as potatoes are used in other countries. The roots, which are divided into a number of parts resembling large carrots, which often take the shape of cow's horns, have a flavor somewhat like parsnips. They are lighter and more palatable than the potato; and they are said to contain more nutriment and to be more digestible. The edible arracacha goes under various designations and even botanists have given it different names, the principal of which are *conium arracacha, arracacha esculenta* and *arracacha* or *arracacia xanthorriza.* The plant has also a variety of native names according to the district in which it is grown. The esculenta variety, which is cultivated extensively in Peru, is known in the English market under the name of the Peruvian carrot. Another variety is grown in the West Indies where it is extensively cultivated and used as an article of food. Some authorities say it is a native of Jamaica, while others assert that the West Indies variety was transplanted there from the mainland. A liquor for the treatment of stomach diseases is also manufactured from the arracacha. In appearance the plant has all the marks of the umbelliferæ family; it is from two to three feet in height and has deeply indented, symmetrical, dark-green leaves and yellowish or dull purple flowers which occur in compound umbels. The arracacha, on account of its prolific growth and its excellent food qualities, was at one time strongly recommended as a substitute for potatoes. Sir William Hooker of the Royal Horticultural Society of England was mainly instrumental in its introduction into Great Britain. The Messrs. Vimorin introduced it into France, cultivated it themselves and induced others to do the same; and Alph de Candolle advocated its cultivation in Switzerland. But all the attempts were failures, as the plant did not grow fast enough to mature before the frost came and killed it; for it requires somewhat warm climatic conditions, more or less evenness of temperature and the unusual conditions that are found on the upland plateaus of the Andes, where the air is, on an average, about one-third lighter than at the level of the sea-coast lands. These conditions include almost constant sunshine and plenty of moisture, never excessive yet constant. The arracacha grows in deep, loose soil and is generally propagated by means of shoots from the crown of the root. In all, more than a dozen species are said to exist throughout the long length of the Andes.

ARRACK, or RACK, a name applied by Orientals to a strong spirituous liquor distilled from rice, from the juice of the cocoanut, date and other palms, or from molasses. The arrack of Gor and Colombo in Ceylon is distilled from palm-juice alone, after being allowed to ferment; that of Batavia and Jamaica from rice and molasses. The rice is turned into malt by being soaked in water and allowed to sprout, after which the arrack is distilled from it on fermentation taking place in the same way as whisky from barley-malt. The rice is also often used without being malted. The distillation of the fermented liquor affords the third or worst sort of arrack; this mixed with a little water and again distilled gives the second best sort; a third distillation produces the best sort, which is seldom exported. The arrack sold in Europe is seldom genuine. Pure arrack is clear and transparent, with a yellowish or straw color, and a peculiar but agreeable taste and smell; it contains at least 52 to 54 per cent of alcohol. Not much of it is imported into England, but it is largely drunk in India and the East generally, the Indian and Pacific Islands, Africa and South America. The arrack of Japan is known as saki.

ARRAGONITE, a common but erroneous spelling for the mineral Aragonite (q.v.).

ARRAH, India, town in Bengal in the district of Shahabad, 33 miles west of Patna. The surrounding country is fertile and well cultivated, and near the town is a large and beautiful lake. It was rendered famous during the mutiny of 1857 by the heroic resistance of a body of 20 English civilians and 50 Sikhs, cooped up within a detached house, to a force of 3,000 Sepoys, who were ultimately routed and overthrown by the arrival of a small European reinforcement. Pop. (1901) 46,170.

ARRAH NA POGUE, ăr-rą nä pōg, a play by Dion Boucicault (q.v.)

ARRAIGNMENT, in the practice of criminal law the calling of a prisoner by his name to the bar of the court to answer the matter charged upon him in the indictment. His innocence being presumed, it is the law, and is so laid down in the most ancient books, that, though charged upon an indictment of the gravest nature, he is entitled to stand at the bar in the character of a free man, without irons or any manner of shackles or bonds, unless there be evident danger of his escape, or of violence at his hands. The indictment is read to him or he is furnished a copy; he is asked by the court whether he pleads guilty or not guilty thereto. If indicted for a felony the criminal must personally appear, but may do so by counsel in case of a misdemeanor. The accused may then ask for time in which to make answer or he may move that the indictment be set aside, or he may demur or plead.

ARRAN, ăr'rąn, Scotland, island in the Firth of Clyde, 20 miles long and 10 miles wide, with an area of 165 square miles. The island attains its loftiest summit in Goatfell, which is 2,900 feet high. The southern portion is rather hilly than mountainous, and contains several arable tracts of considerable extent and tolerable fertility. The geology of Arran has attracted much attention, as furnishing within a comparatively narrow space distinct sections of the great geological formations. The botany possesses almost equal interest, both in the variety and the rarity of many of its plants. Among objects of historical interest are the cave of Drumidoon, relics of Danish forts and Druidical stones. Cattle raising and fishing are the principal industries.

Brodick and Lamlash are the chief harbors, both on the east coast. About half the population speak both Gaelic and English. Pop. (1900) 6,000. Consult 'A May Week in Arran' (1882) and 'The Book of Arran' (edited by J. A. Balfour, Glasgow 1910).

ARRAN, Earls of, the extinct Scottish title of the earls of Arran (not to be confused with the modern Irish earls of Arran — from the Arran or Aran Islands, Galway — a title created in 1762), borne by some famous characters in Scottish history. Except the first earl, Thomas Boyd and James Stewart, all of the earls of Arran were of the Hamilton family. JAMES HAMILTON, 1st earl: b. 1475; d. 1529. He was the son of James, first Lord Hamilton, and Mary Stewart, daughter of James II of Scotland. In 1479 he succeeded to his father's title. In 1489 he was made sheriff of Lanark, appointed privy councillor to James IV, and in 1503 negotiated the marriage between the King and Margaret Tudor. In the same year he was made Earl of Arran. In 1504 he was lieutenant-general of the Scottish realm and took an active part in reducing the Hebrides and was sent to aid John of Denmark with a large army. In 1507 he was Ambassador to France and on his return was imprisoned by Henry VII. When Henry VIII came to the throne Arran signed the treaty of peace between the two countries and was given command of a fleet equipped to aid France. The expedition proved a failure. He returned to find his rival Angus in control of the government, whereupon he turned to the French party, but became weary of it and on the departure of the Duke of Albany was chosen president of the council of regency and provost of Edinburgh. After another short absence he was kept out of Edinburgh by the Douglases and a battle was fought on 30 April 1520 in which the Hamiltons were worsted. But by allying himself with Angus' wife, the Queen-mother, he gained another opportunity for power, which he held from 1522–24, when he was forced to include Angus in the government. Angus was finally conquered in 1526 and Arran joined the King at Sterling. He was succeeded by JAMES HAMILTON, who was also Duke of Châtelherault: b. about 1515; d. 22 Jan. 1575. On the death of James V he was proclaimed protector of the realm and heir presumptive to the throne. He was a zealous supporter of the Reformation. At first he supported the English policy in opposition to Cardinal Beaton, but later joined the French party and became a Roman Catholic. In 1544 he signed a bond repudiating the English alliance. In 1545 he accepted Mary of Lorraine as a sharer in the government, and in the meantime was forced to meet the English army at Pinkie, where the Scots were defeated. He reluctantly agreed to the marriage of the Dauphin with Mary, whom he had designed for his son, and accepting a duchy in France, allowed his title to descend to his eldest son. On 12 April 1554 he abdicated in favor of the Queen-mother, whose government he supported until the capture of Edinburgh by the lords of the congregation, when he declared himself on their side and took the covenant. After several vacillations among the various factions he was declared a traitor and went into exile for five years. He went to France; returned after the murder of Mary's husband and on her abdication was nominated one of the regents, whereupon he returned to Scotland, acknowledged James as king, but treacherously supported the cause of Mary, and when the regency was given to Lennox called a parliament which annulled the King's coronation. In August he was declared a traitor, lost his estates and finally in 1573 acknowledged James' authority and laid down his arms. He married Margaret, daughter of James Douglas, 3d Earl of Morton, and had several daughters and four sons. JAMES, his eldest son, succeeded him as 3d Earl of Arran: b. 1537; d. 1609. He was betrothed to the Princess Elizabeth and was early involved in political broils. He was seized as a hostage in 1546 by the murderers of Cardinal Beaton. Later he went to France in command of the Scots Guards and in 1557 distinguished himself in the defense of Saint Quentin. He was a strong adherent of the Reformed doctrine. At the wish of Mary he was declared a traitor in 1559 and to escape arrest he fled to Geneva and England. He returned to Scotland in September, supported his father against Mary of Lorraine, upheld the alliance with Elizabeth and fought the French at Dysart. He signed the treaty of Berwick, became one of the lords of the congregation and with the strong support of the Protestants and Hamiltons refused the proposals of marriage with Elizabeth and presented his suit for Mary without success. He became a member of her council in 1561, but took a hostile attitude toward her court because of the prevalence of the Roman Catholic religion. He showed marked signs of insanity and was confined in Edinburgh Castle, where he remained until 1566. His estates were administered by his brother John, 1st Marquess of Hamilton. Arran and his mother were besieged on the pretense of delivering him from unlawful confinement and brought to Linlithgow while the charge of his estates was taken over by the government and James Stewart was appointed his guardian. The forfeiture was repealed in 1586 and the title devolved on Arran's nephew, James, 2d Marquess of Hamilton. JAMES STEWART, son of Andrew Stewart, 2d Lord Ochiltree: b. about 1556; d. 1596. In his youth he served with the Dutch forces against the Spanish. Returning to Scotland, he became a favorite of the King. In 1581 he was the principal accuser of the Earl of Morton and for his share in the latter's destruction was appointed a member of the Privy Council. By a grant he became Earl of Arran and Hamilton on the ground of the illegitimacy of the children of his grandmother's father. In the same year he married Elizabeth, daughter of John Stewart. By the raid of Ruthven in August 1582 he was deprived of office and imprisoned. In 1583 he led a force of 12,000 men against the new government and after the overthrow of the Protestant Lords was made governor of Stirling Castle and Lord Chancellor. After executing Earl Gowrie he was made governor of Edinburgh Castle, provost of the city and lieutenant-general of the King's forces. Arran induced the English government to refrain from aiding the banished

lords and further secured his power by the forfeitures of his opponents. His tyranny and insolence caused his rapid fall from power. In 1586 he was ordered to leave the country. In 1592 he returned to Edinburgh, but his attempts to be reinstated were unsuccessful. His career was finally terminated by assassination at the hands of the nephew of the Earl of Morton, who carried his head in triumph on the point of a spear through the country.

ARRAS, ä'räs', France, capital of the department of Pas-de-Calais, in the middle of an extensive and fertile plain, on the Scarpe, which here becomes navigable. It is an important station on the French Northern Railway, is 134 miles by rail from Paris and 97 miles from Brussels. It is a well-built town, and has several handsome squares and a citadel, but is no longer fortified. The chief public buildings are the modern cathedral, the extensive buildings of the former abbey of Saint Vaast, now accommodating a museum and the public library of 50,000 volumes; the Hôtel de Ville, one of the handsomest in the north of France, with a fine Gothic façade; the theatre, Hôtel de la Prefecture, barracks, etc. Its industries are varied and important. These include beet sugar, agricultural implements, hosiery, leather and petroleum products. There is also a large trade in flour, grain, oil, wines, etc. In the Middle Ages it was famous for the manufacture of tapestry, to which the English applied the name of the town itself. The corn-market of Arras is the most important in the north of France. Arras in ancient times was the capital of the Atrebates. It was ceded to Louis XI in 1482, but the inhabitants having revolted, the King stormed it and put the people to the sword or expelled them and named the place Franchise. In 1493 it was ceded to Maximilian of Austria, and was retained by the Hapsburgs until 1640. Arras suffered greatly during the Revolution and again in the European War when it was practically razed by the conflict of British and German guns. During the early stages of the War the French were driven back at Arras on 4 Oct. 1914. About the time fierce battles were raging on the Yser, at La Bassée and Ypres, the Germans made a determined attack on Arras 20 October. They had already bombarded the city during the first week of the month and had attempted to storm it on the 7th. For six days, from the 20th to the 26th, they poured a torrent of shells into Arras. The main attack was made on the 24th; whole quarters of the city were wrecked, but the French line remained firm. Had the Germans succeeded in breaking through they would not only have attained the channel ports and recovered the northern road to Paris, but they would have achieved their main objective, the splitting of the Allied line into two parts, of which the northern must have been annihilated or captured. On the 26th the French under General Maud'huy counter-attacked and drove the enemy out of the front trenches, gradually widening the circle till Arras was beyond the range of the heavy howitzers. The farthest advance of the Germans brought them 11 miles west of Arras in 1914; by January 1918 they had been pushed back eight miles east of the city. Arras was the birthplace of Robespierre. Pop. about 26,000.

ARRATE Y ACOSTA, är-rä'tā ę ą-kōs'tą, a Cuban historian: b. Havana 1697; d. 1766. He studied law in Mexico and Havana and in 1752 was named alcalde of the latter city. His history of Cuba entitled 'Llave del Nuevo Mundo y antemural de las Indias Occidentales' remained in manuscript until 1830. A new edition was issued in 1876.

ARRAWAK, ăr'rą-wąk. See ARAWAKS.

ARREBO, Anders Christensen, a Danish poet: b. Aroöskjobing 1587; d. 1637. He was made bishop of Drontheim, Norway, when only 31, but deposed in 1622, owing to his objectionable life; he was afterward rehabilitated as preacher in Vordingborg. As the pioneer of the Renaissance movement he is considered the father of modern poetry in Denmark. His rhymed translation of the 'Psalms of David' (1623), but especially his 'Hexameron' (1641), an imitation of a once famous poem of the French poet Du Bartas on the 'Creation,' are highly esteemed. Consult the 'Life' by Rördam (Copenhagen 1857).

ARREST, the seizure of a suspected criminal or delinquent that security may be taken for his appearance at the proper time before a court to answer to a charge. Ordinarily a person can be arrested only by a warrant from a justice of the peace; but there are exceptional cases in which he can be apprehended by an officer without a warrant, by a private person also without a warrant, or by what is technically called a "hue and cry."

Any peace officer, as a justice of the peace, sheriff, coroner, or watchman may, without a warrant, arrest anyone committing a felony in his presence, 3 Hawkins Pl. Cr. 164; Tiner *v.* State, 44 Tex. 128; Reg. *v.* Chapman, 12 Cox C. C. 4, or committing a breach of the peace, during its continuance, 3 Wend. (N. Y.) 384, or even to prevent the commission of a breach of the peace, Rex *v.* Herns, 7 C. & P. 312, 32 E. C. L. 522, and such officer may arrest anyone whom he reasonably suspects of having committed a felony, whether a felony has actually been committed or not. 40 N. Y. 463; 3 Park. Cr. (N. Y.) 249; 99 Pa. St. 63.

A private person who is present when a felony is committed, 3 Wend. (N. Y.) 353; 1 Mood. 93; or during the commission of a breach of the peace, 10 Cl. & Fin. Hon. L. 28; 25 Vt. 261, may and should arrest the felon, and may upon reasonable suspicion that the person arrested is the felon, if a felony has been committed. 3 Wend. (N. Y.) 353; 6 Term 315.

An arrest is made by touching the body of the person accused. The object of arrest being to make sure that he answers to a charge about to be brought against him, it does not follow that after being seized he is incarcerated; if bail for his appearance at the proper time be given, and the case be not too aggravated a one for such security to be accepted, he will be released till the day of trial. Consult Freeman, 'Treaties on the Law of Executions in Civil Cases' (3d ed., San Francisco 1900), and Hawley, 'Law of Arrest on Criminal Charges' (2d ed., Chicago 1891).

ARREST, Military. Before an officer or soldier, or other person subject to military law, can be brought to trial, he must be charged

with some crime or offense against the rules and articles of war, and placed in arrest. The articles of war direct that whenever any officer shall be charged with a crime he shall be arrested and confined in his barracks, quarters or tent, and deprived of his sword by the commanding officer, and that "non-commissioned officers and soldiers charged with crimes shall be confined until tried by a court-martial, or released by proper authority." The arrest of an officer is generally executed through a staff officer; by an adjutant, if ordered by the commanding officer of a regiment; or by an officer of the general staff, if ordered by a superior officer; and sometimes by the officer with whom the arrest originates. On being placed in arrest an officer resigns his sword. It is customary, except in capital cases, to allow an officers in arrest the limits of the garrison, or even greater limits, at the discretion of the commanding officer, who regulates his conduct by the dictates of propriety and humanity. A non-commissioned officer or soldier is confined in charge of a guard; but, by the custom of the service, the non-commissioned staff and the sergeants may be simply arrested. The articles of war declare "that no officer or soldier who shall be put in arrest or imprisonment shall continue in his confinement more than eight days, or until such time as a court-martial can be conveniently assembled."

It is declared by the articles of war that "no officer commanding a guard, or provost-marshal, shall refuse to receive or keep any prisoner committed to his charge by any officer belonging to the forces of the United States; provided, the officer committing shall, at the same time, deliver an account in writing, signed by himself, of the crime with which the said prisoner is charged," and it is also declared that "no officer commanding a guard or provost-marshal shall presume to release any prisoner committed to his charge without proper authority for so doing, nor shall he suffer any person to escape, on the penalty of being punished for it by the sentence of a court-martial. Every officer or provost-marshal to whose charge prisoners shall be committed shall, within 24 hours after such commitment, or as soon as he shall be relieved from his guard, make report in writing to the commanding officer, of their names, their crimes, and the names of the officers who committed them." Thus the liberty of the citizen, under military law, so far as is consistent with the ends of justice, seems to be guarded with precautions little inferior to those which secure personal liberty under the civil laws of the State. The penalty of an officer's breaking his arrest, or leaving his confinement before he is set at liberty by his commanding officer, or by a superior officer, is declared to be cashiering by sentence of a general court-martial. A court-martial has no control over the nature of the arrest of a prisoner except as to his personal freedom in court; the court cannot, even to facilitate his defense, interfere to cause a close arrest to be enlarged. The officer in command is alone responsible for the prisoners under his charge. Individuals placed in arrest may be released, without being brought before a court-martial, by the authority ordering the arrest or by superior authority. It is not obligatory on the commander to place an officer in arrest on application to that effect from an officer under his command. He will exercise a sound discretion on the subject. But in all applications for redress of supposed grievances inflicted by a superior, it will be his duty, in case he shall not deem it proper to order an investigation, to give his reasons, in writing, for declining to act; these reasons, if not satisfactory, the complaining party may forward to the next common superior, together with a copy of his application for redress. An officer has no right to demand a court-martial, either on himself or on others; the general-in-chief, or officer competent to order a court, is the judge of its necessity or propriety. Nor has any officer who may have been placed in arrest any right to demand a trial, or to persist in considering himself under arrest, after he shall have been released by proper authority. An officer under arrest will not make a visit of etiquette to the commanding officer or other superior officer, or call on him, unless sent for; and in case of business he will make known his object in writing. It is considered indecorous in an officer in arrest to appear at public places.

ARREST OF JUDGMENT, in law, is the act or process of preventing a judgment or verdict from being carried out till it shall be ascertained whether it is faulty or legally correct. Judgment may be arrested (1) when the declaration made varies from the original writ; (2) where the verdict materially differs from the pleadings and issue thereon; and (3) where the case laid in the declaration is not sufficient in law to admit of an action being founded upon it. A motion for arrest of judgment must be grounded on some objection arising on the face of the record itself. People *v.* Thompson, 41 N. Y. 1; People *v.* Kelley, 94 N. Y. 526. If the judgment is arrested all the proceedings are set aside, and judgment of acquittal is given, but this will be no bar to a new indictment. See JUDGMENT and consult works there referred to.

ARRETIUM, ăr-rē-shĭ-ŭm. See AREZZO.

AR'RHENATHE'RUM, genus of three species of tall perennial grasses closely allied to the oat (q.v.). *A. elatius* or *avenaceum* (also known as *Avena elatius* and *Holcus avenaceus*), which, as these names imply, bears a resemblance to oats, and is sometimes called oat grass and French rye grass, is widely cultivated for fodder in France. True rye grass (*Lolium*) is, however, not a close relative. It is grown in the United States as a hay grass, but is confined to the States east of the Mississippi.

ARRHENIUS, ăr-rā'nĭ-ŭs, **Svante August,** Swedish chemist and physicist: b. Wijk, 19 Feb. 1859. He was educated at the University of Upsala and after making many original investigations became professor in the University of Stockholm in 1891. His researches have been of the highest importance, the establishment of the theory of electrolytic dissociation being due to him. This theory supplies a reasonable explanation of many chemical phenomena otherwise insoluble and correlates various hitherto unconnected facts. In 1903 he was awarded the Nobel prize in chemistry. He has published 'Sur la conductibilité galvanique des électrolytes' (1884); 'Lärobok i teoretik'

(translated into German and English, 1900); 'Lehrbuch der komischen Physik' (1903); 'Immunochemistry' (1907) embodying the course of lectures which he delivered in 1904 at the University of California; 'Das Werden der Welten' (1907), published in English as 'Worlds in the Making' (1908), a widely discussed work which maintains the theory of the perpetual self-renovating energy of the world against the Clausian theory of final glacial decay, and initiates the theory of universally diffused life, emanating continually as spores from all habitable worlds, which, unless destroyed by contact with flaming stars, propagate life on habitable worlds they may reach.

ARRIA, celebrated Roman matron, wife of Cæcinna Pætus, consul during the reign of Claudius, about 41 A.D. Pætus having raised an unsuccessful revolt against Claudius, in Illyria, was condemned to die, but was allowed the option of ending his life by suicide, which the Romans did not deem a crime. Pætus hesitated; Arria seized the dagger, plunged it into her bosom, and then presenting it to her husband, said, "It is not painful, Pætus." She fell dead and Pætus at once killed himself with the weapon. Arria was the mother of Arria, who became the wife of P. Clodius Thrasea Pætus.

ARRIAGA, är'rę-ä'ga, **Manoel de,** 1st President of Portugal: b. Horta, Azores, 1842; d. 5 March 1917. Began practising law in Lisbon and became one of its foremost lawyers. He was always a Republican by conviction, and in 1861 he was sent to the Chamber of Representatives by the Republicans. It was here, where he served his party for many years, that he gained a reputation as a fluent speaker. At one time he was offered the position of tutor to the royal princess, but this honor he refused as inconsistent with his Republican principles. He took a leading part in the revolution which in 1911 dethroned the King and proclaimed the republic; on 24 August of that same year he was elected the 1st President of the republic, receiving 121 votes as against 86 cast for Senhor Machado. See PORTUGAL — HISTORY.

ARRIANUS, Flavius, a celebrated Greek philosopher and historian: b. Nicomedia, Bithynia, who flourished in the 2d century under the Emperor Hadrian and the Antonines. He was a disciple of Epictetus, whose lectures he edited. While residing in Greece he gained the friendship of the Emperor Hadrian, who bestowed upon him the citizenship of Rome (124 A.D.), and subsequently appointed him prefect of Cappadocia. He was afterward advanced to the senatorial and even consular dignities. Like Xenophon, whom he imitated in style, he united the literary with the military character. His writings were numerous, but many of them have perished. His 'Anabasis' of Alexander the Great, still extant, narrates the Asiatic expedition of Alexander, and being based on the memoirs of Ptolemy Lagus and Aristobulus, who both served under that King, is proportionably valuable. To this is added a book on the affairs of India, which pursues the history of Alexander, but is not deemed of equal authority. An epistle from Arrianus to Hadrian is also extant, entitled 'Periplus Ponti Euxini' (A Voyage Around the Euxine or Black Sea). There are also ascribed to him 'Treatise on Tactics'; and a 'Periplus of the Sea of Azof' and of the Red Sea, of which the authority is doubtful. We possess also his 'Enchiridion,' a moral treatise containing an abstract of the practical philosophy of Epictetus. There have been various editions of the 'Enchiridion' and the 'Anabasis.' His philosophical works have been translated by T. W. Higginson (Boston 1891) and the 'Anabasis' by Chinnock (1893). For biographies consult Bolla, E., 'Arriano di Nicomedia' (Rome 1890); Pelham, H., 'Arrian as Legate of Cappadocia' (*Eng. Hist. Rev.* October 1896).

ARROL, SIR William, British engineer: b. Scotland 1840; d. Ayr, 20 Feb. 1913. Apprenticed to a smith at Paisley in boyhood, he worked in various engineering shops, and set up as a boilermaker in a small way in 1865. In 1872 he started the Dalmarnock Iron Works, and gradually took up construction work in steel. His first important work was the Caledonian railway bridge at Glasgow. He reconstructed the Tay bridge after the disaster of 1879, which occupied five years, and the Forth bridge, 1882–89. He also built the steel work of the Tower bridge, London, and the Nile bridge at Cairo, and widened Blackfriars bridge across the Thames. Arrol devised many ingenious implements for drilling, riveting and other operations. Originally a Liberal, he left the party in the Home Rule split of 1886 and sat as Unionist M.P. for Ayrshire 1895–1906.

ARRONDISSEMENT, ä'rôn-dęs-măn, name given in France to the 362 subdivisions of the 87 departments, or of the quarters of some of the larger cities, as in Paris. The arrondissement is under the government of a sub-prefect.

ARROO. See ARRU ISLANDS.

ARROW, a missile weapon, straight, slender, pointed and barbed, to be shot with a bow. See ARCHERY.

ARROW LAKE, the name given to an expansion of the Columbia River, in British Columbia, about 95 miles long from north to south. It is often regarded as forming two lakes — the Upper and Lower Arrow.

ARROW-MAKER, The. This play, reflective of American Indian life, especially of the Paiutes, in the Sierras, is by Mrs. Mary Austin. Presented at the New Theatre, New York, under the management of Winthrop Ames, in February 1911, certain concessions had to be made, so the author confessed, "to what was thought to be the demand for a drama of Indian life which should present the Indian more nearly as he is popularly conceived." But, even in the presentation, care was taken that the music be reminiscent of Indian themes, that the chants be played from phonograph records of Indian ceremonials, that the dances be taught by one Chief Red Eagle, and that the costumes and properties have the authenticity of the American Museum of Natural History. When the play was revised and issued definitely in 1915 (Boston), its notes and glossary revealed Mrs. Austin's desire to make of 'The Arrow-Maker' an archæologically correct representation of the Indian as known to her.

The central character in the drama, The Chisera, is a Medicine Woman of the Paiutes — who, in commune with the gods, is supposed to be as one removed from human passion. Those who come to her regard her as an intermediary, with the power of influencing the Great One. They all work her "to their best advantage." But The Chisera tires of lonely commune and gives her love to Simwa, the Arrow-Maker. In the tribal matters that follow this complication the drama is a tragic revelation of Indian plotting and deceit. The Chisera is deserted by Simwa for the chief's daughter, and though this Medicine Woman has not been taught the potent exercise of hate, she ceases to exercise her power of intercession with the gods. And this brings misfortune to the tribe and grief to those involved in the way of Simwa and of one Padahoon, both rivals for tribal leadership. The final curtain falls on the death of The Chisera, mortally wounded by one of her own enchanted arrows.

Apart from its archæological faithfulness, 'The Arrow-Maker' is a dignified attempt to write an American Indian drama. It is the latest in a long line of Indian dramas, the first of which, Maj. Robert Roger's 'Ponteach,' was written in 1767.

MONTROSE J. MOSES.

ARROW-ROOT, a fine-grained starch esteemed for making desserts and invalid foods. It is extracted from the underground parts of various tropical plants, especially of the genus *Maranta* of the family *Marantaceæ*. The popular name is said to be derived from the practice of the South American Indians who used the freshly dug rootstocks as an antidote for poisoned arrow-wounds. Probably, however, the derivation is from the Indian word *ara*. The principal species is *Maranta arundinacea,* indigenous to tropical America and cultivated in the West Indies, India and other warm countries. It is a perennial plant about two feet high, has small white flowers and fruits about the size and form of currants. The rootstocks, which often exceed a foot in length and three-quarters of an inch in diameter, are yellowish white, jointed and covered with loose scales which must be carefully removed before the extraction of the starch, because they impart their disagreeable flavor if allowed to remain. The process of extraction, which is simple but usually crudely practised, is as follows: The rootstocks are dug when a year old, well washed, peeled, beaten to a milky pulp in deep wooden mortars, and well washed to remove the fibrous parts, which are thrown away. The crude starch is next passed through a sieve or a coarse cloth and allowed to stand until the starch has settled, when the water is drawn and the white residue again washed. After again settling, the water is drawn off and the pulp when dried in the sun is reduced to powder. On a large scale arrow-root is manufactured with the aid of specially constructed machinery, but the process is essentially as described. Bermudian arrow-root is considered the best in the market, and next to it is that of Jamaica. The East Indian product is believed to be inferior, perhaps because of adulteration with or substitution of other starches, practices induced by the great demand and the high prices paid for the genuine. Some of these other starches are obtained from closely related plants, among which may be mentioned certain species of the genera Canna (q.v.), Curcuma (see TURMERIC), Manihot (see CASSAVA), Tacca (q.v.), and Arum. Potato, corn, rice and wheat starch and fine sago are also sold for arrow-root, but may be identified by microscopical examination; the form and markings of the starch grains differ from those of the arrow-root granules. When dry, arrow-root is odorless, but when damp has a slight smell. Like other carhohydrate foods, it is a source of energy, but since it is deficient in nitrogen compounds it should be mixed with eggs, milk or other substances rich in nitrogenous materials, to form a well-balanced diet.

The amount of fecula or starch present in the roots of the *Maranta* varies according to age, and runs from 8 per cent, in those of the young plants, to 26 per cent when full grown. The latter stage is reached when the plant is 10 to 12 months old; and the roots then present the following composition in 100 parts:

Starch, fecula, or arrow-root	26
Woody fibre	6
Albumen	1½
Gummy extract, volatile oil, and salts	1
Water	65½

Arrow-root is exported in tin cases, barrels or boxes, carefully closed up. It is a light, opaque, white powder, which, when rubbed between the fingers, produces a slight crackling noise like that heard when newly fallen snow is being made into a snowball. Through the microscope the particles are seen to be convex, more or less elliptical, sometimes obscurely triangular, and not very different in size. The dry farina is quite inodorous, but when dissolved in boiling water it has a slight peculiar smell and swells up into a very perfect jelly. Potato starch, with which it is often adulterated, may be distinguished by the greater size of its particles, their coarser and more distinct rings, and their more glistening appearance. Refined sago flour is used for adulteration, many of the particles of which have a truncated extremity, and their surface is irregular or tuberculate. Arrow-root is also sometimes adulterated with rice starch and with the common starch of wheat flour.

The starch of the cassava, manihot or manioc is sometimes imported into Europe under the name of Brazilian arrow-root. Potato starch, carefully prepared, is sometimes sold as English arrow-root; and the farina obtained from the roots of *Arum maculatum* as Portland arrow-root. Otaheite arrow-root is the starch of *Tacca pinnatifida.* All these, as well as Oswego and Chicago corn flour — the starch of maize or Indian corn — are so nearly allied to true arrow-root as not to be certainly distinguishable by chemical test; but the forms of the granules differ, so that they can be distinguished by the microscope.

ARROWHEAD, *Sagittaria,* a genus of plants of the natural order *Alismaceæ,* distinguished by unisexual flowers, having three herbaceous sepals and three colored petals, numerous stamens and numerous carpels, which are compressed, one-seeded, and on a globose receptacle. They are aquatic plants, natives of very different climates, from the tropics to the cold regions of the world. The common arrowhead (*S. sagittifolia*) is a beautiful plant, a native of England, with arrow-shaped leaves

which rise above the surface of the water. It is one of those plants which have enjoyed an undeserved reputation as cures for hydrophobia. The corms (or solid bulbs), dried and powdered, have sometimes been used for food, but have an acrid, unpleasant taste. The Chinese arrowhead (*S. sinensis*) is a native of China, and has long been cultivated in that country and Japan for its eatable corms, which, in a fresh state, are somewhat acrid, but abound in starch. It has arrow-shaped acute leaves and a branched polygonal scape (leafless stem). It is grown in ditches and ponds and is one of the plants sometimes cultivated in tanks in hothouses.

ARROYO, ăr-rō'yō (Sp. «stream») the name of two towns of Spain, in Estremadura. Arroyo del Puerco, about 10 miles west of Caceres, has a palace of the old dukes of Benevente, and a parish church adorned with some paintings by Morales, Arroyo Molinos de Montanches, about 27 miles southeast of Caceres, is noted as the scene of the defeat of the French, 28 Oct. 1811, by the British under Lord Hill.

ARROYO, Porto Rico, town in the department of Guayama. It is situated on the south coast of the island, at the head of the harbor of the same name, being 40 miles southeast of San Juan. It is the centre of a rich sugar-producing region and exports much rum and molasses. In 1899 it was partially destroyed by a hurricane. Pop. 3,220.

ARRU (a-roo') **ISLANDS,** a group belonging to the Dutch, situated to the south of western New Guinea, and extending from north to south about 127 miles. They consist of one large island and a number of smaller. They are all low and swampy, but well wooded and tolerably fertile. The natives belong to the Papuan race, and many of them have been converted to Christianity by Dutch missionaries. The chief exports are trepang, tortoiseshell, pearls, mother-of-pearl and edible birdsnests, which they exchange for European goods. Agriculture is in a primitive state, but maize, sugar-cane, beans, bananas, etc., are cultivated. Sago is the chief diet, little animal food being eaten. Pop., mainly Papuans, about 23,000.

ARSACES, ăr-să-sēz, founder of a dynasty of Parthian kings, who, taking their name from him, are called Arsacidæ.

ARSCHOT, or ÆRSCHOT, Philippe de Croy, Duke of, Flemish statesman: b. Valenciennes, France, 1526; d. Venice, 11 Dec. 1595. The heir to the wealth of the Croy family, he adopted the profession of arms and received his knighthood from the Spanish King Philip II, who employed him on diplomatic missions. His fanatical zeal for the Roman Catholic Church brought him into great favor with his royal patron and led to his appointment, in 1577, as military governor of Antwerp citadel after the withdrawal of the Spanish troops. Hated by most and mistrusted by all, he was nevertheless appointed governor-general of Flanders by the State Council, which was composed of nine members, himself being the chief one. During a riot at Ghent he was captured by the populace, who exacted from him a promise to resign his post. He took some part in the administration of the Netherlands at a later period. The story of his devious career is told by Motley, who describes him as «a splendid seignor, magnificent in cramoisy velvet, but a poor creature,» and that he was «to serve all, essay to rule all, and to betray all.» (The Rise of the Dutch Republic).

ARSENAL, a magazine, or place appointed for the making, repairing, keeping and issuing of ordnance and other appliances required in warfare, whether in the army or navy. Sometimes the name is applied to an establishment where such articles are kept in store only, but the chief arsenals also embrace large factories or workshops. The principal arsenals of the United States are those in Allegheny, Pa.; Augusta, Ga.; Benicia, Cal.; Columbia, Tenn.; Fort Monroe, Va.; Frankford, Pa.; Indianapolis, Ind.; Augusta Me.; New York, N. Y.; Rock Island, Ill.; San Antonio, Tex.; Watertown, Mass., and Watervliet, N. Y. There are also powder depots at Saint Louis, Mo., and Dover, N. J., a noted armory at Springfield, Mass., an ordnance proving ground at Sandy Hook, N. J. The Royal Arsenal, Woolwich, England, which manufactures warlike implements and stores for the army and navy, was formed about 1720. In France, each territorial military district (19 in all, including Algeria) has its own special arsenal or its own depot of war material. In continental Europe establishments corresponding to our navy yards are included under the general term arsenal, such as are found in France at Cherbourg, Brest, Lorient, Rochefort and Toulon. The chief arsenals of Germany are situated at Spandau, Cologne and Dantzig, that at the first-mentioned place being the great centre of the military manufactories. The chief Austrian arsenal is the immense establishment at Vienna, which includes gun-factory, laboratory, small-arms and carriage factories, etc. Austria also purchases quantities of her military stores from private manufacturers. Russia has her principal arsenal at Petrograd with supplementary arsenals elsewhere. In Italy, Turin is the centre of the military factories. One of the most important naval arsenals on the Mediterranean is at Cartagena, Spain.

ARSENIC, steel-gray metal having a high lustre when freshly broken but soon tarnishing. It is very brittle and has a specific gravity of 5.7. Compounds of this element have been known for many centuries, chiefly on account of their poisonous character. The yellow sulphide of arsenic, otherwise called «orpiment,» was known to Dioscorides, who called it *arsenikon*, probably on account of its powerful properties; the Greek word *arsen*, from which it is derived, signifying «male.» Arsenic occurs in the metallic form in nature, usually with ores of iron, silver, lead, cobalt, nickel and antimony. Large masses of it are found at Zimeoff, in Siberia, and it occurs also in Saxony, Alsace, Bohemia, Transylvania, in the Harz, in Chile, in Japan, at Kongsberg in Norway, and in the United States in New Hampshire, Maine, Colorado and Washington, and in British Columbia. Combined with other substances it is one of the most widely distributed of the elements, although the total amount of it in the world does not appear to be large. It occurs in various kinds of pyrites, and is therefore a common impurity in sulphuric acid (much of which is made from pyrites), and in substances in the manufacture of which this

acid is used. The minerals known as kupfernickel (niccolite), realgar, orpiment, mispickel (arsenopyrite), and nickelglance (gersdorffite) contain it, as well as many others. The appearance of metallic arsenic varies greatly with the source from which it is obtained, and the method adopted for preparing it. That obtained from pyrites is usually compact, crystalline and nearly white, while that obtained from arsenious acid is gray and pulverulent. Metallic arsenic may be obtained by refining the element as it occurs in nature, or by extracting it from arsenopyrite. The process of extraction from arsenopyrite consists in roasting that mineral in earthenware retorts or tubes arranged horizontally in a long furnace, and each having a piece of thin sheet-iron rolled up and inserted into its mouth. On distilling, most of the arsenic condenses on the sheet-iron, from which, after cooling, it may be detached. The product so obtained is further purified by mixing it with pulverized charcoal and redistilling. The earthenware retorts that are used in the process are made with great care. They are composed of one part of fresh clay and two parts of pulverized bricks or old retorts, and are coated with a mixture of blood, loam, forge scales and alum, which produces a glaze through which the poisonous vapors of the arsenic cannot penetrate. They are then fired. Practically all the arsenic marketed in the United States is a by-product of the smelting of arsenical lead and copper. In 1916 there were made in this way 5,986 short tons valued at $555,186. It would have been as easy to have made 20,000 tons had there been a demand for it. Owing to the fact that the smelters which work on arsenical pyrites (chiefly copper) are located in the Far West, a price of four cents a pound in the New York market is the minimum at which the production of arsenic as a by-product becomes commercially advantageous. It is interesting to note that besides the domestic production there was imported into the United States, in 1916, 1,071 tons of white arsenic, and 1,092 tons of orpiment (arsenic sulphide). The total value of these imports was $232,694.

Arsenic is crystalline, and its hardness, on the mineralogical scale, is about 3.5. It has several allotropic forms, one of which is crystalline, and the other black and amorphous. The specific heat of the crystalline variety is 0.083, and that of the amorphous variety is 0.076. Arsenic conducts electricity better than mercury does; for if the specific resistance of mercury at 32° F. be taken as unity, the specific resistance of arsenic is 0.373 at 32° F., and 0.534 at 212° F. The chemical symbol of arsenic is As, and its atomic weight is about 74.44 (Clarke). Its coefficient of expansion is .000-00311 per degree F. Arsenic oxidizes slowly when exposed to the air, forming a gray powder which is sometimes sold under the name of "fly-powder." It is not affected by pure water. When heated in the air it burns with a blue flame, giving off a characteristic, highly disagreeable, garlic-like odor. When protected from the air, metallic arsenic volatilizes at a red heat without melting; its vapor being a light citron yellow, and phosphorescent. When heated under heavy pressure arsenic melts at about 900° F.

Metallic arsenic forms alloys with many metals, some of which are produced by pulverizing and intimately mixing the constituents, and subjecting them to a pressure of 6,000 or 7,000 atmospheres. If much arsenic be present the alloys are usually brittle. Arsenic is an undesirable impurity in iron, in general, but it is sometimes added to iron and steel for the manufacture of small chains and ornaments, because it makes the metal susceptible of a very brilliant polish. When alloyed with copper, arsenic gives a brittle gray metal, having a brilliant, silvery appearance, which is used to some extent in making buttons The chief use of metallic arsenic, however, is in the manufacture of small shot. Pure melted lead, when dropped from a height, tends to form tailed drops; but if arsenic be added in small quantities this tendency disappears and the drops are nearly spherical. Another important use of metallic arsenic is in the manufacture of special alloys for bearings. With hydrogen, arsenic forms a very important gaseous compound known as arseniuretted hydrogen, or arsine, and having the formula AsH_3. This compound is best obtained by the action of sulphuric acid upon an alloy of arsenic and zinc. It is colorless, and so poisonous that Gehlen, its discoverer, was killed by inhaling a single bubble of it. Arseniuretted hydrogen burns with a bluish flame, and metallic arsenic is deposited upon a cold body that is held in the flame. Marsh's test for arsenic depends upon this fact. In executing this test, zinc and sulphuric acid are added to the solution to be tested, and the hydrogen evolved is allowed to issue from a small jet, where it is lighted. A piece of cold white porcelain is then held in the flame, and if arsenic be present, the characteristic dark, metallic, mirror-like deposit will be produced, owing to the arseniuretted hydrogen that is evolved, simultaneously with the hydrogen. Antimony gives the same kind of a deposit, so that it is important to examine the deposit (or "arsenical mirror," as it is technically called), to make sure that it is not composed of antimony. Marsh's test is extremely delicate, and will demonstrate the presence of incredibly small traces of arsenic, if proper precautions are taken to ensure absolute purity in the zinc and sulphuric acid that are used. Scheele's green (known chemically as "arsenite of copper") is a compound of copper arsenic, oxygen and hydrogen of a light green color. It was formerly much used in calico printing and for wall paper. Schweinfurth green is a different compound of the same elements, and is used for similar purposes. A great diversity of opinion has prevailed among chemists as to the danger of using arsenical colors, especially in connection with wall papers. Some maintain that "there is no possibility of any arsenical exhalation arising from the walls, as has been alleged"; while others claim that certain microscopic fungi and other low forms of vegetable life act upon these coloring matters and cause the production of arseniuretted hydrogen, which can actually be detected in the air of rooms hung with arsenical papers. Schweinfurth green is better known in the United States by the name "Paris green," and is much used for preventing the destruction of crops by insects.

The most familiar compound of arsenic (with the possible exception of Paris green) is

undoubtedly arsenious oxide, As_4O_6 (often written As_2O_3), or "white arsenic," known to the general public simply as "arsenic." This is used extensively in the arts, in the manufacture of indigo blue and aniline; in glass-making, to remove the color due to the lower oxides of iron; in fly and rat poisons; in taxidermy; in making fireworks; and for several other purposes. Paris green and London purple are used in large quantities as insecticides. Arsenic is used in medicine in the treatment of anæmia and asthma. Not all persons, however, can take it. In homœopathic treatment in minute quantities it is administered for several ailments.

ARSENICAL POISONING. Arsenic is now used in so many ways that accidental poisoning occurs very often. As a poison employed in committing suicide, and for slow poisoning with homicidal intent, it is less in favor than formerly. The forms of poisoning mostly seen are of the chronic type. These occur from the use of paints containing large quantities of either Scheele's green or Paris green: the use of spraying solutions, now widely employed as a means of protection from insect and fungus pests, and from the addition of arsenic to foodstuffs, as a preservative. Acute forms of poisoning are more often the result of attempts to commit suicide. In acute arsenical poisoning the early symptoms are those of an acute inflammation of the stomach and intestines, coming on about half an hour after taking the poison. If taken when the stomach is empty the symptoms may be exhibited within 10 minutes; if when the stomach is full, the effects may not appear for 10 to 12 hours. The premonitory symptoms of distress, difficulty in swallowing and a burning pain in the throat, are followed closely by violent cramp-like pains with nausea, vomiting and diarrhœa. The severe symptoms multiply, the diarrhœa becomes watery, "rice water" and blood may appear in the vomit. A cold, damp skin of bluish hue, feeble and irregular heart-action, collapse and sighing respiration may precede death, attended at times with convulsions. Death may occur within 24 hours, but it is apt to be delayed from two to four days, the patient usually dying of the secondary degenerations in the organs and of exhaustion. Examination of an arsenically poisoned body after death shows arsenic in nearly every part, particularly in the liver and kidneys. It is found also in the brain and even in the spongy parts of the bones. Death by arsenic is very painful. It is, moreover, an extremely uncertain poison, because of its insolubility, and of the vomiting reaction it induces. Many acute cases pass into the chronic stage.

Chronic arsenical poisoning may result from a single large dose, but more often results from the long-continued use of small quantities of the poison. In a recent outbreak of chronic arsenical poisoning in Manchester, hundreds of people were affected. The source of the poisoning was from arsenic in iron pyrites employed in making sulphuric acid; this certain sulphuric acid had been utilized in the manufacture of glucose. Several firms had purchased this glucose for the manufacture of beer, and many hundreds of the consumers of this beer suffered from various forms of arsenical poisoning. Chronic arsenical poisoning may result from the use of wall papers and hangings colored by arsenical dyes, although such modes of poisoning may be considered extremely rare. The symptoms of this type of poisoning are of gradual onset: the patient is languid, weak and loses his appetite. There is discomfort in the intestines, pains similar to colic and diarrhœa or constipation may result. A sub-acute inflammation of the mucous membrane of the nose and gums then develops, with sore gums, puffiness under the eyes with inflammation of the lids and running from the nose. Sneezing, coughing and hoarseness may occur, various skin eruptions are not uncommon and a curious pigmentation of the skin is nearly always observed. The patient progresses until poisoning of the ends of the nerves begins, with disturbances in sensation, anæsthesia, paræsthesia and pain. There may then develop paralysis of the extremity, frequently the toe (drop-toe); or the wrist (drop-wrist). Paralysis of sensation may also occur. The course of a chronic poisoning may not be over three or four days, but it usually requires three or four weeks, sometimes longer. Some individuals use arsenic throughout their lives and are never poisoned. The treatment of acute poisoning consists in the thorough and prolonged washing out of the stomach and the use of large quantities of magnesia. Supportive treatment is needed in the stage of collapse. Heat, alcohol and coffee are indicated. Brandy and ether are administered hypodermically and morphine is injected to allay the acute suffering. In chronic poisoning electricity and tonic treatment are required. See ARSENIC.

ARSENIOUS ACID, the arsenical compound familiarly known and popularly called arsenic. It is obtained principally during the roasting of the arsenican nickel ores in Germany in furnaces communicating with flues. The ordinary arsenious (which is what is popularly known as arsenic) is a white crystalline powder, decidedly gritty, like fine sand, and with no well-marked taste. It is very heavy, so much so as at once to be noticeable when a paper or bottle containing it is lifted by the hand. It is soluble in water, to the extent of one part of acid in about 100 parts of cold water, and one part of acid in about 10 parts of boiling water. When placed in a spoon or other vessel and heated, it volatilizes and condenses in crystals on any cool vessel held above. By this means it can be distinguished from ordinary flour, which, when heated, chars and leaves a coal behind; and from chalk, stucco, baking-soda, tooth-powder and other white substances that, when heated, remain in the vessel as a non-volatile white residue. In some countries, as in the mountainous regions of Austria, Styria and the Tyrol, arsenic is eaten habitually, beginning with small doses and gradually increasing them. It is said to clear the complexion, favor nutrition and to improve the respiration in ascending heights. Some of the "arsenicophages" can take great quantities with impunity. See MINERAL PRODUCTION OF THE UNITED STATES.

ARSENOLITE, a native trioxide of arsenic, having the formula As_4O_6 (often written As_2O_3), and crystallizing in the isometric system — usually in octahedrons. It is commonly white, with a vitreous lustre. Its hardness is

1.5, and its specific gravity about 3.71. It occurs in connection with ores of silver and lead, and with those of other metals when arsenic is associated with them. In the United States it has been found in Nevada and California. Arsenolite and senarmontite (an antimonial mineral of analogous composition and similar crystalline form) are collectively known by mineralogists as the "arsenolite group."

ARSENOPYRITE, ar-sen-o-pī'rīt ("arsenical pyrites"), a tin-white, opaque mineral, with a metallic lustre, crystallizing in the orthorhombic system. It contains arsenic, iron and sulphur, and has the formula FeAsS. Its hardness varies from 5.5 to 6.0, and its specific gravity from 5.9 to 6.2. Arsenopyrite is largely used as a source of "white arsenic," or arsenic trioxide. It occurs chiefly in the crystalline rocks with gold and ores of silver, lead and tin. It abounds in Germany, England and the United States.

ARSENYEV, Konstantin Ivanovich, är-sän'yef, Russian statistician, historian and geographer: b. 12 Oct. 1789; d. Petrazavodsk, 29 Nov. 1865. He was the son of a priest of the village of Mirkhanov, government of Kostroma, Chukhlomski district. He was educated in the Seminary of Kostroma and the Pedagogical Institute of Saint Petersburg, from which he was graduated in 1810. A year later he was appointed instructor of geography and Latin at the institute. In 1819 the institute was changed to the University of Saint Petersburg and Arsenyev became adjunct professor of geography and statistics. He was dismissed, however, two years later on the charges of free-thinking and teaching rules destructive to the morality of the students. He continued, however, teaching in the School of Engineers and Artillerists where he also held a position. In 1824 he became instructor in statistics and history to Crown Prince Aleksandr II. He undoubtedly influenced the mind and the character of the future Tsar-Liberator. Quitting his duties as educator of the Crown Prince, he entered the civil service, at the same time devoting himself to scientific work. He held the position of head statistician of the Ministry of the Interior (1832–53), then newly organized. He did a great deal for the organization of Russian statistics and can be called one of its fathers. In 1845, together with Count Th. P. Litke, he founded the Geographical Society of which he was associate-chairman (1850–54). He had attained the rank of privy councillor at the time of his death. His most valuable contributions are his historical work 'The Rule of Peter II' (Saint Petersburg 1839); 'The Rule of Catherine I' (Saint Petersburg 1856). As the educator of the Crown Prince he had access to the documents of the imperial archives and ministerial bulletins. This enabled him to enrich Russian history with many new data. His 'Statistical Sketches of Russia' (Saint Petersburg 1848), for which he used unpublished documents of the department of mines of the Ministry of the Interior and other government bureaus are also of great value. Besides the works mentioned he wrote 'The History of the People and the Republics of Ancient Greece' (Saint Petersburg 1825–26); 'Short General Geography' (ib. 1818, 20th ed., 1849, the only textbook for 30 years); 'Survey of the Physical Conditions of Russia and its Advantages for the Existing Public Industries' (Saint Petersburg 1818). He also contributed a number of articles and studies to current periodicals. Consult 'Historical Papers of K. I. Arsenyev' edited posthumously by Pekarski in Saint Petersburg 1872. It represents a collection of documents from archives and has Arsenyev's biography attached to it.

ARSINOË, är-sĭn'ō-ē, the name of several celebrated women of antiquity, the most noted of whom is the daughter of Ptolemy I of Egypt, and Bernice: b. about 316 B.C.; she married Lysimachus, King of Thrace, in 300 B.C. Desirous of securing the crown for her own children, Arsinoë persuaded Lysimachus to put Agathocles, the son of his former wife, to death. This crime proved fatal to the Thracian king; for Lysandra, the wife of the murdered prince, fled with her children to the court of Seleucus Nicator of Syria, who took up arms in her favor. In the course of the war Lysimachus was slain and his kingdom taken possession of by the conqueror. Arsinoë now fled into Macedonia, which was soon overrun by the Syrian army. In less than a year afterward, however, Seleucus was assassinated by Ptolemy Ceraunus, half-brother of Arsinoë. This queen, who held the city of Cassandria in Macedonia, was induced, under promise of marriage, to admit Ptolemy within its walls; but no sooner had he entered than her two children were butchered before her eyes. She succeeded in making her escape to Egypt, where she became the second wife of Ptolemy II, Philadelphus, her own brother (279 B.C.), thus affording a precedent to these unnatural unions which afterward became common among the Greek rulers of Egypt. She bore no children to her brother, who, however, seems to have had a strong affection for her, as he called one of the districts of Egypt by her name and employed the architect Dinochares to build a temple in her honor. The first wife of Ptolemy II, also named Arsinoë, was a daughter of Lysimachus. A daughter of Ptolemy III, also of the same name, married her brother Ptolemy IV. Cleopatra's younger sister, Arsinoë, was taken prisoner by Julius Cæsar and later ordered by Mark Antony to be put to death, 41 B.C.

ARSINOË, city of ancient Egypt, on Lake Mœris, said to have been founded about 2300 B.C., but renamed after Arsinoë, wife and sister of Ptolemy II, of Egypt. The site of Arsinoë is now occupied by the town of Medinet-el-Faium. The sacred crocodiles were kept here.

ARSON, the malicious and wilful burning of a dwelling-house or out-house belonging to another person by directly setting fire to it, or even by igniting some edifice of one's own in its immediate vicinity. If a person, by maliciously setting fire to an inhabited house, cause the death of one or more of the inmates, the deed is murder, and capital punishment may be inflicted. When no one is fatally injured the crime is not capital, but is still heavily punishable; it is a penal offense also to attempt to set a house on fire, even if the endeavor does not succeed. The New York Penal Code provides that a person who wilfully burns, or sets on fire in the nighttime, either (1) a

dwelling-house in which there is, at the time, a human being; or (2) a car, vessel, or other vehicle, or a structure or building other than a dwelling-house, wherein, to the knowledge of the offender, there is, at the time, a human being, is guilty of arson in the first degree. Many statutory changes have been made in the common law upon this subject. There are three degrees of arson in the State of New York. Arson in the first degree is punishable by imprisonment for any term not exceeding 40 years; in the second degree by imprisonment for a term not exceeding 25 years; in the third degree for a term not exceeding 15 years. Before the crime of arson is complete, the house, or some portion of it, however small, must be burned, or consumed by fire.

ARSUF, Palestine, a town on the coast, 12 miles north of Jaffa, famous as the scene of a victory of the crusaders under Richard I of England over the army of Saladin.

ART, in its broadest sense, is the purposeful exercise of human activities for the accomplishment of some predetermined end of use or pleasure. Art is thus set apart from Nature which exists and operates outside of man, and which can enter the domain of Art only when and in so far as man calls her into his service by employing her powers for his own purposed ends. The distinction between Art and Nature, and the relations between them, have been a fruitful subject of philosophical discussion, which cannot here be summarized, as it nowhere contravenes the definition given above. Art is also distinguished from Science, which investigates phenomena, declares facts, and lays down rules, but does not, as Science, execute the operations dictated by these rules. It is Art which, having conceived the end to be realized, learns from Science the laws and rules which must be observed in the exercise of the activities by which the preconceived end is to be attained, and then applies them to that end.

While in the above-defined broad sense the name of art may be applied to the commonest human activities controlled by the will for a definite end — so that one may speak of an art of eating or walking — in general usage it is confined to such activities as involve ingenuity, judgment and skill. In this sense one speaks of the art of fishing, of building, of dress-making, of piano-playing. And in nearly all uses of the term there is present the idea of *producing* or *creating*, which is warranted by the etymology of the word in nearly all languages. The Latin *Ars*, from which we derive the English Art, is traceable to an ancient root *Ar* which is believed to signify a creation or begetting. Hence the word is also applied to the generality or totality of the products of the human creative activity in a given field, place or age, as when one speaks of mediæval art, American art, the art of the Flemish looms, referring not to the activity which created, but to the products of that activity.

In ancient and mediæval times, the whole field of liberal culture was embraced in the term "arts" or "liberal arts"; and this usage survives in the modern degrees of Bachelor of Arts and Master of Arts and the name "Faculty of Arts" or "College of Arts" traditionally applied to certain faculties and institutions engaged in liberal education as distinguished from professional education. Generally, however, modern usage prefers the term "culture" to "arts" to designate the whole body of non-professional or theoretical education and activity, in which are included literature, philosophy, language, history and pure science.

From the foregoing observations it will be seen that in every occupation, trade or pursuit there are involved both an art and a science. The carpenter who makes a box must first conceive mentally — that is imagine — the box he is to produce, and exercise his activities to bring this conception into being: this is Art. Science teaches him the nature of his materials, and the laws which must control the use of his tools and materials to realize his conception. Then Art again appears in his application of his mental powers of skill and judgment and of his bodily powers of muscular activity, in conformity with the rules and laws of Science, and the box which is the product of this application is a work of the carpenter's art.

The mental preconception of a work of art, whether recorded in visible form by a drawing or specification or not, is a *design*. So in the art of war, the commander's predetermined plan of campaign or system of strategy is a design, as truly as is the architect's drawing of a projected building, or the weaver's pattern of the proposed rug or brocade. Thus in every art there are two distinct elements or stages — design and execution. Design springs from the imagination, and guides and directs the execution. Everything that pertains to the execution is a part of the *technic* of the art; the rules and laws of the technic are the contribution of Science.

Classifications.— It is customary and convenient as well as reasonable to distinguish between those arts which minister primarily to the physical or material needs of man, and those whose primary and dominant purpose is to minister to man's emotions, apart from practical or material service. The arts of the first sort we call the *useful arts*; those of the second sort the *fine arts*. The products of the useful arts are designed for purposes external to themselves, to serve the needs of daily life; in other words they are made to be used. The products of the fine arts, on the other hand, are created for their own sake; they are an end in themselves, or — to be more accurate — they exist for the sake of the emotions they are designed to express and arouse. A chair, however superbly carved, is primarily a work of useful art, because made primarily to be sat on; but a picture is painted for its own sake, not to be used but to be looked at and to excite pleasurable emotions by its beauty of subject, of drawing, of color: it is a work of fine art. So also a poem or a symphony is produced for the sake of the æsthetic emotions it arouses, not for that of any practical or material use to which it is to be put; it is a work of fine art. The fine arts, then, are those whose appeal is to the æsthetic emotions; and just to the extent in which any work of art does so appeal does it enter within the domain of the fine arts. Painting, sculpture, music and pottery belong obviously in this domain; pottery, weaving,

building, metal-working are as obviously useful arts.

Since, however, useful objects are often made of such forms and so adorned as to be not only useful but also beautiful to look upon, and therefore to appeal to the æsthetic sense, there is seen to be a wide border-land of art in which both use and beauty are kept in view, and both skill and imagination exercised by the designer and maker of the useful object. The arts which are thus concerned with making useful objects beautiful are sometimes called the *industrial* arts, sometimes the *decorative* arts. But these terms cannot be used either as synonyms or as mutually exclusive designations, for by many the name "industrial arts" is applied to the useful arts, as such; while certain of the decorative arts belong wholly in the category of fine art. (See FINE ARTS). Indeed, architecture, which is universally classed as a fine art, is the most important of the decorative arts, to which many of the decorative arts are ancillary and subordinate, such as mosaic, decorative carving, marble inlay and the like. (See DECORATIVE ART). It is therefore evident that any classification of the arts into rigid categories such as the scientists have devised for their fauna and flora or for the sciences themselves is quite out of the question, because of the varying degrees to which the utilitarian and æsthetic elements prevail in the different products of man's industry, and in different works even of the same general kind.

Sciences Related to Art.— In connection with the arts, especially the fine arts, there have been developed a number of fields of intellectual activity which are not themselves arts, but rather sciences, although they concern themselves wholly with inquiries into matters of art. The investigation and discussion of the nature of beauty and of the appeal which works of art make to the emotions is a branch of philosophy, and is called *Æsthetics* (q.v.). The study of the origin, achievements, progress and decline of the arts or of an art is a branch of history, especially of the history of civilization. The exploration of ancient remains and the study and discussion of the arts of a more or less remote antiquity constitute the science of *Archæology* (q.v.). The discussion of the qualities, characteristics, merits and defects of an art, a style or a period of art, or of a particular work of art, is a special branch of *Criticism* (q.v.). The principles and laws at the basis of an art and the rules for its practice form a body known as the Theory of Art, closely related to the science of æsthetics. Every one of these divisions of knowledge concerning Art and the arts has given birth to an extensive literature, and the amount of such literature is enormous. Thus, for example, in the Avery Library of Columbia University at New York, there are at this writing 25,000 volumes devoted exclusively to architecture and the allied arts.

For information concerning various divisions of the general subject see the articles ABORIGINAL ART; ÆSTHETICS; AMERICAN ART; ARCHÆOLOGY; ARCHITECTURE; DANCING; DECORATIVE ART; INTERIOR DECORATION; DRAMA; FINE ARTS; MUSIC; OPERA; PAINTING; PAINTING, AMERICAN; PAINTING, EDUCATION IN; POETRY; PYROTECHNY; SCULPTURE; SCULPTURE IN THE UNITED STATES; SCULPTURE, EDUCATION IN; and the various industries or useful arts each under its own title.

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ART, American. See AMERICAN ART.

ART, Decorative. See DECORATIVE ART.

ART, Ecclesiastical. See ECCLESIASTICAL ART.

ART DRAWING: Pictorial Representation and Decorative Design. Drawing in general falls into two distinct divisions, namely, Constructive Drawing and Art Drawing. Constructive or Mechanical Drawing is a conventional method of representing all the facts of form, size and structure of an object from which the object may be constructed. Art Drawing deals with the representation of the appearance of objects and the evolving of forms for the decoration of surfaces. As taught in art academies and practised in studios, it comprises the subjects of Pictorial Representation and Decorative Design.

PICTORIAL REPRESENTATION.

As the title implies, the ultimate aim of pictorial representation, commonly known as free-hand drawing, is the creation of a picture — the graphic expression of the beautiful in plant-life, animal-life and landscape. A true picture shows not merely how an object or group of objects appears, but it tells how these objects impressed the artist. It is the draughtsman's concrete effort to communicate to his fellow beings the æsthetic sensation he experienced in the presence of nature.

To attain his end, the artist must augment a natural aptitude for the subject by a study of linear and aerial perspective in landscape and marine drawing, anatomy in figure and animal drawing, and the principles of selection and arrangement (pictorial composition) in all the types of representation. He must, moreover, be acquainted with the qualities and limitations of the several forms of rendering and mediums used.

Free-Hand Perspective.— In looking thoughtfully at a landscape, we shall notice that objects diminish in size as they recede farther and farther from the eye; and that forms we know to be rectangular or circular appear modified according to the different positions in which they are placed in relation to the observer. These changes in form and size are due to what is termed *linear perspective.* We shall also notice that objects in the distance appear paler and grayer in color, due to the action of what is called *aerial perpective.*

The draughtsman need not necessarily go into a scientific study of linear perspective; but he must embody in his work what is known as free-hand perspective — the general principles of the subject deduced from observation and practice. These principles are herewith stated:

1. The apparent form of any object, except a sphere, varies with every position in which it is placed in regard to the observer.

2. The apparent size of an object decreases as its distance from the observer increases.

3. A circle seen obliquely always appears like an ellipse.

4. The more obliquely the circle is seen, the more nearly the ellipse approaches a straight line.

5. A horizontal face, when above or below the eye, appears fore-shortened.

6. All parallel horizontal edges receding from the eye appear to converge to a point on the horizon — an imaginary line on a level with the eye.

7. Parallel horizontal edges receding to the left appear to converge to a point on the horizon at the left of the object, called Vanishing Point 1; those receding to the right appear to converge to the right of the object, called Vanishing Point 2.

8. For rectangular objects standing with the side faces turned equally away, the vanishing points are equidistant from the object. (Fig. 1).

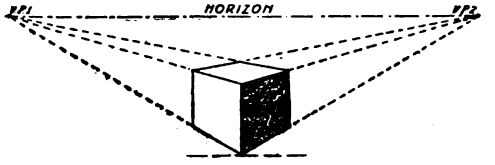


FIG. 1

9. For rectangular objects standing with side faces turned unequally away, Vanishing Points 1 and 2 are unequally distant from the object according to the angles at which the objects stand. (Fig. 2).

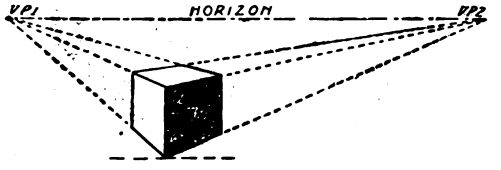


FIG. 2

10. Receding parallel lines situated obliquely in relation to the observer appear to converge in a vertical vanishing line. (Fig. 3).

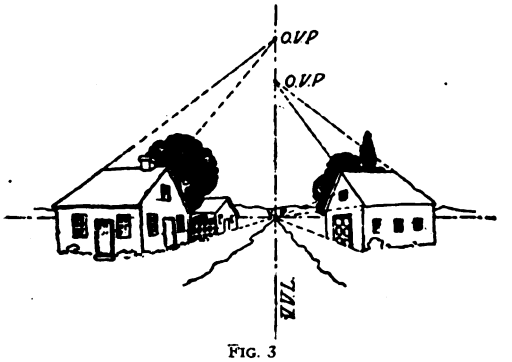


FIG. 3

Forms of Rendering.— There are four modes in which objects may be rendered. They may be drawn in outline, in neutral values of light and dark, in light and shade, or painted in color masses. With the last form of rendering we are not concerned in this article. See PAINTING.

Rendering in Outline.— The practice of drawing in outline as an independent form of pictorial representation is not much in vogue now, as it is more or less abstract and limited in its power to convey to the mind all the truths in the appearance of an object. Nevertheless, an experienced artist can express many characteristics of an object by a skillful modulation of line: now thin, and then thick; here long, graceful and rhythmic, and there short, hard and angular.

Rendering in Flat Values of Light and Dark.— On a gray day when the sky is overcast, the light does not come from a particular spot, but is rather diffused from the sky generally. We shall find that then all the elements in a landscape, as trees, buildings, distant hills, etc., appear in simple flat masses of color. If we interpret in black and white the characteristic forms and relative degree of light and dark, called the values, of these color masses, we shall have a landscape drawing rendered in flat values of light and dark.

This method of rendering is now frequently used by artists in still-life, landscape and figure compositions where decorative effects are required, as in poster work and mural decorations. (Fig. 4).

Rendering in Light and Shade.—A drawing made in light and shade seeks to express the values of the masses as modified by the effect of sunlight and shadow. It is the most realistic of all the methods of pictorial representation in monochrome, as it depicts all the characteristics of the subject with the exception of its actual color. (Fig. 5).

Pictorial Composition.— In order to express his idea perfectly and beautifully, whether it be in still-life, landscape or animal drawing, the artist must use in his work the fundamental principles underlying good arrangement of lines and masses in a picture, known as pictorial composition. These principles are:

1. Dominance, which requires that there be one object or centre in a picture of major interest, having the strongest emphasis or accentuation and all other objects subordinate.

2. Opposition, which requires that the various elements in a composition show contrast and variety of line, shape, and value.

3. Balance, which requires that there be such an adjustment of these contrasts that the whole effect will be harmonious.

In the charcoal drawing, «Sheep Entering a Barn,» by the famous Dutch painter Anton Mauve (Fig. 6), we have an example of good composition. The eye first discerns the principal elements, namely, the old man and the sheep, because they occupy a dominant position (near the centre), and their values are accentuated at the expense of the other details, which are purposely kept subdued. Besides, a little scrutiny will reveal that the picture also has ample contrast and variety in line, shape, and tone, and perfect balance of its various attractive forces.

Mediums Used in Drawing.— Of the various materials used in drawing, the most important are lead-pencil, ink and charcoal, each having its special qualities and limitations.

Lead-pencil Drawing.— The lead-pencil has always been a favorite with artists in mak-

ing preparatory studies for their pictures, and a number in the past, as Lalanne, Ingres, Rousseau and Legros, have used it as an independent means of expression. The technique of lead-pencil drawing is very simple. For ordinary outline work a medium soft pencil is used, held by the thumb and fore-finger three or four inches from the point so that it has the support of the middle finger. The shading is rendered by means of broad intermingled strokes of a soft pencil (4B), held sideways under the fingers. This method is known as pencil-painting. (Fig. 5).

Ink Drawing.—There are three kinds of ink rendering: pure line drawing, made with a pen; tone drawing produced with a brush; and combination drawing of lines supplemented by tones.

In a pure line drawing in ink, the draughtsman seeks to render the light and dark values in his subject by means of pen strokes of graded widths. For this purpose India ink and pens of special make are used. (Fig. 7).

An ink tone drawing is made with washes produced by means of a sable or camel's hair brush and India ink, diluted with quantities of water according to the intensity of the tones desired.

Combining lines and tones in an ink drawing is now very popular with artists, as this method is capable of producing highly interesting effects.

Charcoal Drawing.—One of charcoal's admirable characteristics is that it produces a wide range of subtle grays. Its pale tones are semi-transparent silvery grays, so useful in depicting aerial perspective, and its dark tones are rich and velvety, extremely valuable in landscape and figure drawing generally.

Its chief quality, however, lies in the fact that it is easily removed, enabling the artist to alter the arrangement of the masses as he composes. These changes are done with the chamois skin and kneaded rubber.

When completed, the drawing can be made permanent by spraying with a solution of white shellac and alcohol, called fixative.

DECORATIVE DESIGN.

By design is meant the originating of objects and their decoration according to the laws of use and beauty. It thus naturally falls into two grand divisions, namely, constructive design and decorative design.

Constructive Design, or design in three dimensions, deals with the evolving of objects having length, breadth and thickness. It covers all the fields of human invention, as vessels, utensils, apparel, furniture, architecture and machinery. Each of these forms a distinct department of design. We thus speak of architectural design, machine design, jewelry design, etc.

The chief aim of constructive design is the creation of an article of use and beauty. The object designed must show fitness for its purpose in size, form, material, and in beauty of its proportion. For example, we would be violating the laws of use and beauty if we were to make a chair out of cardboard, the size of a table, and in the form of a pyramid.

But very often objects, although fully satisfactory in themselves as regards use and beauty, nevertheless present blank surfaces the appearance of which might greatly be improved by the application of ornamentation. This leads us to a consideration of decorative design.

Decorative Design, or design in two dimensions, may be defined as the evolving of forms for the enrichment of surfaces. The result of decorative design, commonly known as ornament, produces its legitimate effect when, without concentration upon itself, it makes the object to which it is applied more pleasing than if unadorned.

To produce satisfactory work, the decorative designer must study the materials of design, the systems and principles of arrangement, and the various methods of application.

Materials of Decorative Design.—Designs may be produced from abstract shapes, from conventionalized natural forms, as plants, animals and landscape, and from lettering.

Abstract Forms in Design are derived from the exhaustless field of geometry. They are arrived at by combining lines of various widths, or by cutting up such geometric surfaces as the square, oblong triangle, circle, etc., into smaller interesting areas. (Fig. 8).

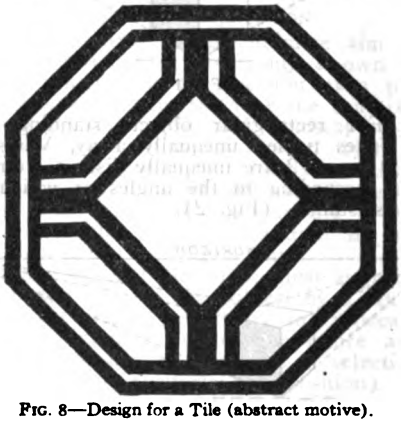


FIG. 8—Design for a Tile (abstract motive).

Nature Forms in Design.—By far the most important elements of design are derived from plant-life, animal-life and landscape. But as the decoration of an object should be subordinate to the object itself, a realistic treatment of a nature subject is not permissible. Before being applied it must be conventionalized.

Conventionalization.—By conventionalization is meant the adaptation of a natural form for design purposes. In a botanic drawing of a flower, for instance, the various organs, as petals, sepals, pistil and stamen are studied with minuteness and all the wonderful structure is revealed. But in drawing it for decorative purposes, the flower is idealized, by keeping only the general characteristics of growth, form and proportion, while simplifying outlines, rejecting unimportant details, and rendering it in flattened values.

Conventionalization may be formal or informal. A nature motive is formally conventionalized, when its elements are decidedly simplified in outline, form and value, and symmetrically arranged.

Informal conventionalization refers to the use of the perspective appearance of a nature

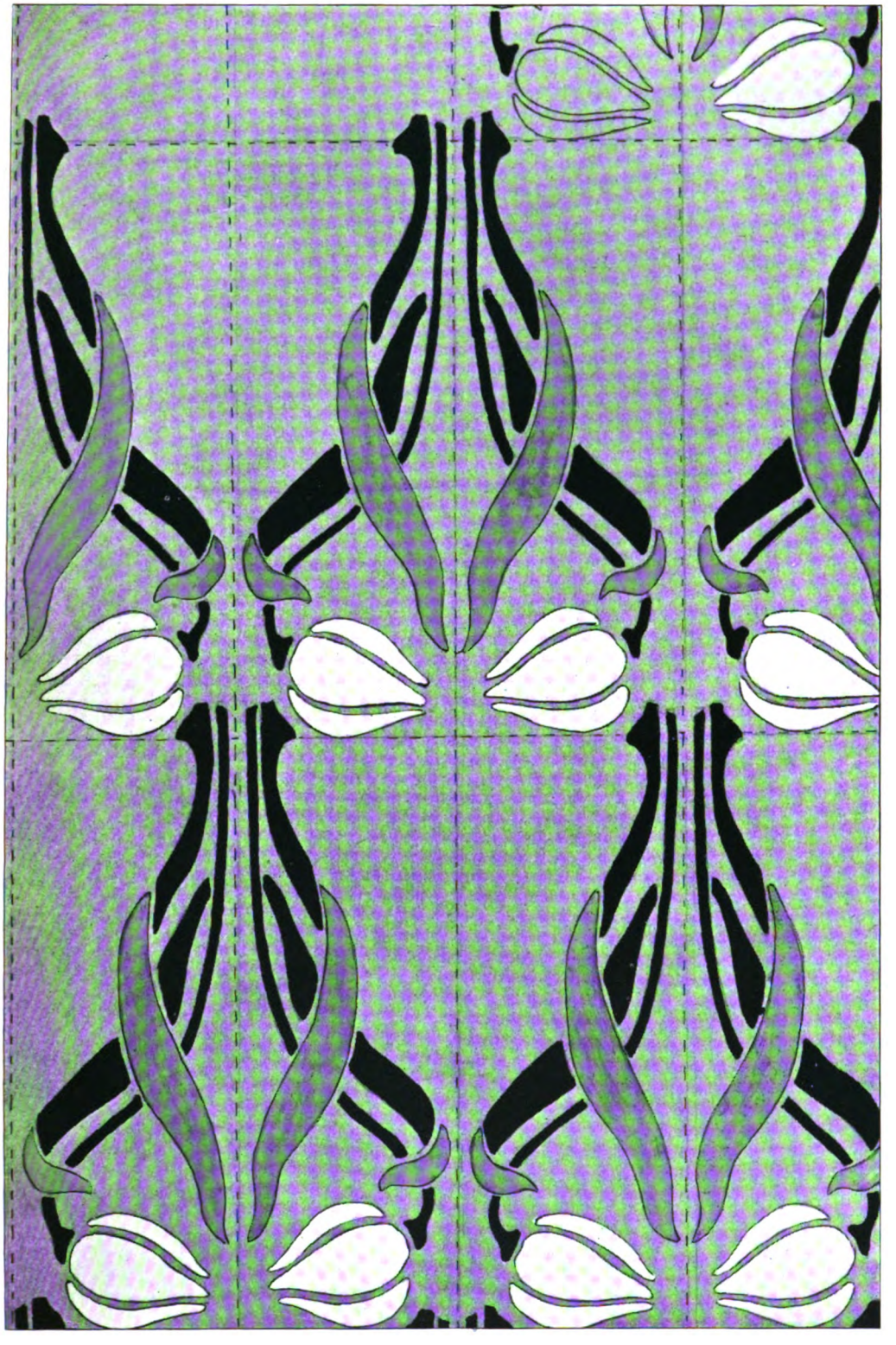


Fig. 11 — The Anatomy of an all-over Pattern (full drop alternate repeat)

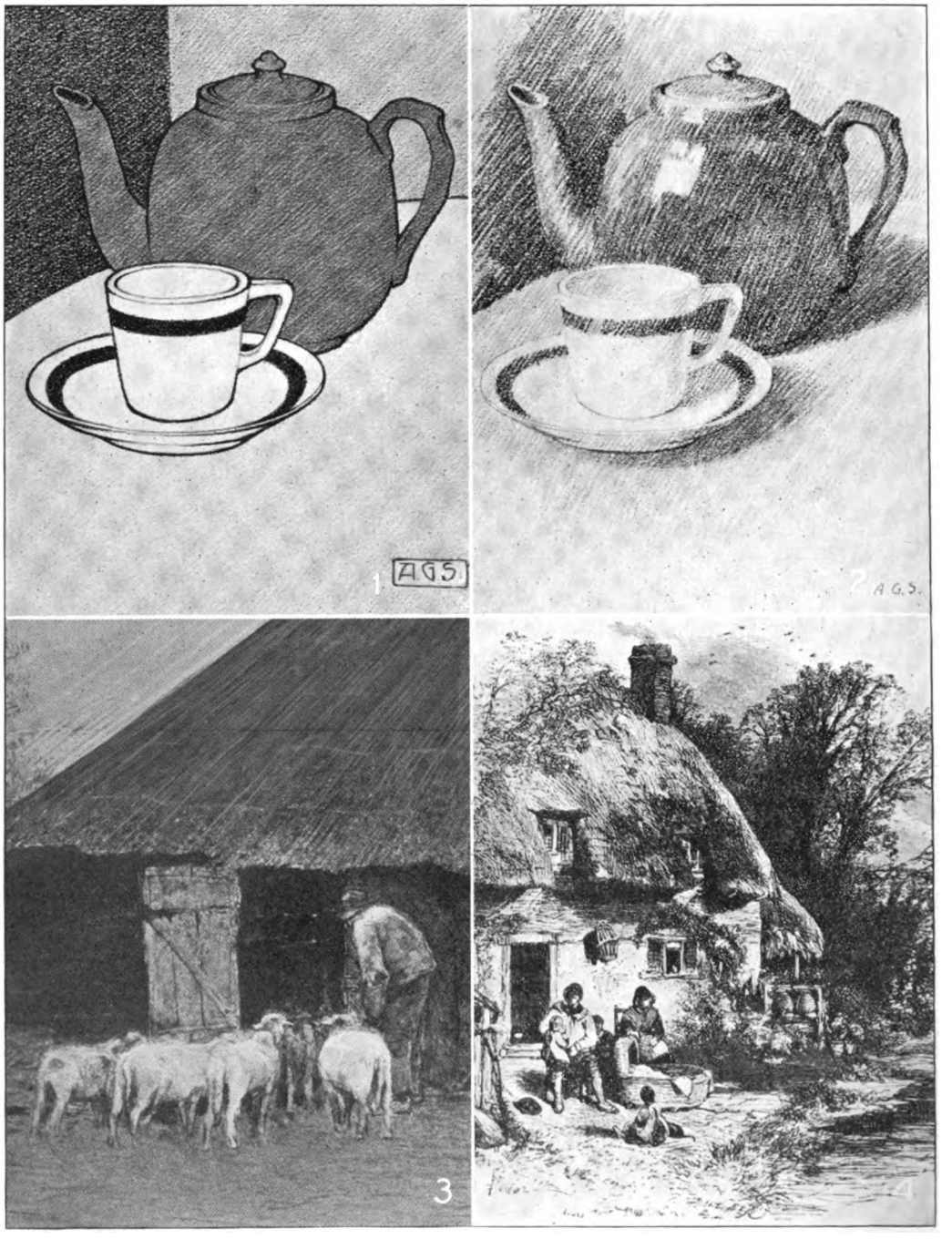


Fig. 4 (1) A Still-life Drawing, rendered in light and shade
Fig. 5 (2) A Still-life Drawing, rendered in light and shade. Example of Pencil Painting
Fig. 6 (3) A Charcoal composition by Anton Mauve (Dutch)
Fig. 7 (4) A Pen and Ink Drawing by Birket Foster (English)

subject but slightly modified for decorative purposes.

Systems of Arrangement.— The principal forms of decorative arrangement include:

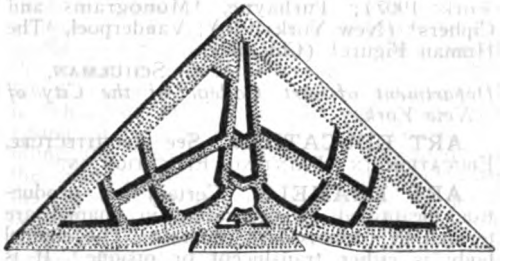
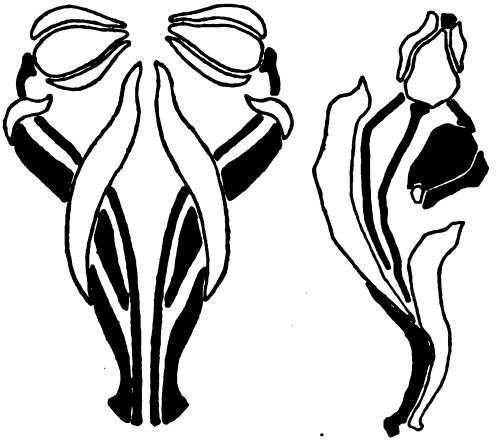


FIG. 9—Design for Blotter-pad Corner in Pierced Metal. Example of a design for an enclosed area.

1. Designs for unlimited areas, or all-over patterns.
2. Designs for partly limited areas or borders.
3. Designs for limited or enclosed areas. (Fig. 9).



A B

FIG. 10—Design Units. A—Formally balanced. B—Informally balanced.

In each of these kinds of design, what is termed the *unit,* or motive, is repeated in a particular mode. The unit of design is a simple decorative figure, either symmetrically arranged, or informally balanced about a vertical line. (Fig. 10).

All-over Patterns, as designs for textiles, cretonnes and wall-papers, are developed by the rhythmic repetition of a unit over a surface in all directions. When the unit is repeated in rhythmic rows which are both horizontal and vertical the design is called a *full drop regular repeat;* when the unit is repeated in alternating rows, the pattern is known as a *full drop alternate repeat.* (Fig. 11). In what is termed a *half drop repeat,* the unit is repeated in alternating rows in which every other row is dropped one-half the height of the unit.

This regular recurrence of a unit over a surface in such a way as to lead the eye consistently through all parts of the pattern is called *rhythm,* which is responsible for a great deal of the charm that obtains in all kinds of surface design.

Borders.— Borders, or designs used for limiting surfaces, are produced by the rhythmic repetition of a unit in one direction. (Fig. 12).

Lettering in Design.— Lettering forms the major motive in designs for monograms, bookplates book-covers and posters. The alphabets now generally used are the modern Gothic and Roman.

Monograms.— A monogram is a character consisting of two or more letters, interwoven into one, usually the initials of a name or several names. Besides unity, balance and rhythm, which are essential in all surface design, the special principle governing a good monogram is *intricacy.* By this is meant the pleasing effect obtained by a happy interlacing or interweaving of the letters. The more subtle the interweaving, the more attractive the design. (Fig. 13). Unity in a monogram is best obtained by a proper distribution of the letters within any geometric surface as a square circle, kiteform, hexagon, etc. Monograms are generally applied to jewelry, stationery and linen.

FIG. 13—Design for a Monogram.

Bookplates.— A bookplate or «Ex Libris» is the little label or plate put into a book by its owner. The designer must introduce into the bookplate as much as possible the character, taste, ambition or hobby of the person, for whose library the plate is designed. For

FIG. 12—Design for a Border.

instance, if the person is romantic,— knights, castles and brave deeds appeal to him — a decorative treatment of a castle would be appropriate. The lettering, of course, plays the most important part. It should be legible and in such a style as will suit the general idea, and must have a well thought out and important position. (Fig. 14).

FIG. 14—Design for a Bookplate.

Book-covers.— A design for a book-cover generally contains several lines of lettering, that is, the title and the name of the author, and an ornament. The ornament may be a purely decorative figure, or a decorative treatment of a landscape, marine or figure composition, suggesting the contents of the book. All the lettering on the cover should be of the same style, and the title made conspicuous by the use of intense tones.

Posters.— A poster is a placard announcing an event, or advertising an article. It is considered effective, naturally, when it attracts attention, and excites interest in the event announced or the article advertised. To impart this attractive power to his design, the poster designer makes use of either some catch phrase, or some peculiar pictorial decoration, or a combination of both.

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ART EDUCATION. See ARCHITECTURE, EDUCATION IN; PAINTING, EDUCATION IN.

ART ENAMELS. Certain art productions beautified by decoration in enamel are termed by connoisseurs *enamels.* The enamel body is either translucent or opaque. It is composed of a frit or flux of lead glass. The lead ingredient has for its chief purpose the lowering of the melting point of the medium. This vitreous body, by the addition of metallic oxides, produces a colored translucent enamel. (See ENAMEL). It is rendered opaque by a proportion of bone-ash or of oxide of tin. Ground to a degree of extreme fineness this body is washed and moistened to the required consistency and then applied to the article to be decorated. It is then melted in a *muffle* oven and thereby adheres, in its fused condition, to the surface of the metallic background. The origin of the word enamel is its French synonym *émail.* In most methods of art enameling the reverse side receives a coat of enamel; this so-called *contre-émail* reduces the risk of the glassy decoration splitting or splintering off in the process of cooling.

Proofs lead to the supposition that the art of enamel decoration originated in the East. Any trace of the date of its discovery is lost, but the art dates very far back. The several different processes can be brought under the two heads: "Incrusted" (i.e., inlaid), such as *champlevé* and *cloisonné*; and that superficially applied, the *émaux peints,* and the so-called "Venetian" enamels. It had been quite generally supposed that the colored vitreous inlays in extant specimens of ancient Egyptian decoration were enamel work. Flinders-Petrie, however, declares they are inlaid pieces of glass and that the early Egyptians were not able to do enamel work on metal. But there are extant examples of Greek cloisonné enamels dating from the "finest Greek period" (about 400 B.C.). Brooches (*fibulæ*), and horse-harness plates extant of Gallic origin show enamel work. Several vessels and pieces of personal adornment existing with enamel decoration appear to have been made somewhere between the 2d and 3d centuries A.D. In Ireland and England numerous wonderfully artistic and perfectly enameled ornaments have been dug up from the soil, proving that the Celts and Anglo-Saxons were experts in enamel decoration. Of such we have the Ardagh chalice, Tara brooch, King Æthelwulf's gold ring, King Alfred's jewel, brooches, pins, rings, armor, horse-harness plates, etc., in blue, vermilion, green, white enamel. These are in *champlevé* work.

Cloisonné Enamels.— The process of cloisonné work is, briefly, the following: Wire is bent into curves and angles to form the outline of the design required. This wire network is soldered or otherwise fastened to the

metal surface which is to form the base on which the decoration is to be applied. The different colored enamel powders are next used in filling in the open spaces or cells (*cloisons*). Then the piece is subjected to the muffle oven to fuse the enamel. When cooled the enamel is found to have melted down below the level of the wire. Additional enamel is "charged" to fill the cells again, and the fusing process is repeated. This process of filling the cells and fusing is continued till the enamel, after fusion, is about level with the top of the wire. The surface of the piece is then filed off flat (termed *stoned*). If left with its natural surface after firing it is termed *flushed*. The surface is next given a friction polish. The early art of enameling in the West appears to have died out, but in the East (about the 7th century) the art was practised in Byzantium (ancient Constantinople). It was cloisonné work. Of this period (in Byzantine enamels) there is extant the "Iron Crown" of Lombardy at Monza. (See CROWNS). Of later dates are the "Paliotto" or San Ambrogio altar (835) by Volvinius in Milan (see ALTAR) made to the order of Archbishop Angilbert; the processional cross of Emperor Lotharius I (795–855) in the Cathedral of Aix-la-Chapelle. The votive crown in Saint Mark's, Venice (9th century), has enamel ornament. An enameled reliquary in Limburg (containing a piece of the Holy Cross) by its inscription informs us it was made to the order of Emperor Constantine VII (976). Gospel (*Textus*) covers of the 10th century of beautiful cloisonné decoration extant are several in Saint Mark's, Venice, one each in Saint Gall and Sienna. Some gold plates in the National Hungarian Museum, Pest, with their cloisonné pictures of the Emperor Konstantine IX, Monomachos and the Empress Theodora and Zoe are, probably, parts of a crown, and date from 1042 and 1054. The Hungarian Stephan's crown (see CROWNS) has enameled plates in both arches and the circlet. The Pala d'Oro (see ALTAR) in Saint Mark's, Venice, was formerly an antependium and the enamel picture was made for Doge Pietro Orseolo I in Constantinople (976) and the added enamel plates were done for Doge Ordelafo Falieri (1105). Quite a large number of works were produced in Constantinople in Byzantine style for the European churches, such as reliquary caskets (*chasses*), crosses, book-covers, etc.; some show an inscription as proof. Under competition with the new *champlevé*, Byzantine enamels disappear about the 12th century.

Champlevé Enamels.— The process of champlevé enamel work consists of carving recesses in the body of the metal base and leaving the outline of the design on the metal untouched. In other words, instead of placing a network of wire to represent the design's outline (as with cloisonné) the body is carved away leaving only the outline as upper surface. The sunken recesses are filled in with enamel and *fired* (fused) and finished as with cloisonné work. A defect in the cloisonné process is the fact that it is practical only on a gold, silver, gilt or a copper base. Champlevé work can be practised on the baser metals, thus greatly reducing the expense of the material. No *contre-émail* is required in this style. The French often term this style *en taille d'épargne*. By the 11th century Germany was resorting to *champlevé* enamel work on copper, and we find, for about two centuries, first one style alongside the other or the two methods displayed in one and the same piece. Whether Germany preceded Limoges in the production of champlevé or the reverse seems to be a never-ending discussion. We are assured that Abbé Suger, of Saint Denis (1144), had work done by goldsmiths from Lorraine. Champlevé style was termed, in the 12th century, *opus Lemoviticum* quite frequently. But the Rhine provinces (Cologne, etc.) and Lower Saxony were active centres for this work at this time. While the Rhine product came from monasteries, that of Limoges was produced in workshops of civilians; the former, therefore, have tendencies toward ecclesiastical symbolism, and the latter display simple, popular subjects and fewer inscriptions. Some early examples extant follow: Portable altars, one in the Treasury at Berlin; another in the Bamberg Cathedral (chest with flat cover), was, traditionally, a gift of the Emperor Heinrich (1002–24), having angel figures of enamel on the cover, Christ, Holy Virgin and Disciples on the sides. Enamel work is on the ambo (pulpit) at Aix-la-Chapelle; two crosses of similar form are in the Welfenschatz of Hanover, where are also two reliquary chests (*chasses*), one of which is the same Byzantine church form as that in the South Kensington Museum, from the Soltykoff collection. The other is in the form of a portable altar, rich in combined champlevé and cloisonné, and has the inscription "Eilbertes Coloniensis Me Fecit." Siegburg also has several enamel decorated reliquaries and portable altars of Cologne workmanship. Saint Mary's Church, Cologne, has two very fine reliquaries, one of Saint Maurus, the other of Saint Albin. A noted example is the sarcophagus of Charlemagne in Aix-la-Chapelle Cathedral. The richest of enameled reliquaries is that of the "Three Kings" in Cologne Cathedral with its chased work, precious stones, cameos and enamel work in cloisonné and champlevé (end of 12th century). The so-called "Verdun altar" in Klosterneuburg, near Vienna, was an antependium in 1181, and consisted of 45 plates, but six were added in 1329, producing an altarpiece with wings. The plates have scenes from the Old Testament and the Evangels. The enamel triptych from Alton Towers, now in the Victoria and Albert Museum (London), was made at Huy by Godfrey de Claire middle of the 12th century. Of the 73 Limoges champlevé examples in Cluny Museum the two plates representing Saint Stephen de Muret are of the 12th century. In the Paris Louvre, among 80 Limoges champlevé pieces we find a rosette-shaped plate displaying the Vision of Saint Francis of Assisi; it is of the 13th century transition period, when the entire picture becomes covered with enamel and engraved work. In this new style the background is enameled but the figure is bare metal and engraved with line work. This left most of the art work to the engraver and the enamel took second consideration. This 13th century innovation soon caused decadence in art enameling. In Italy some work was done in champlevé,

mostly on small plates of copper or silver, for the decoration of crucifixes, chalices, etc. They display, of course, Italian design. In Spain champlevé work was done in the 16th century.

Émaux en Basse-Taille.— Called also *translucent enamel work*. This style is a combination of sculpture and enameling. It originated with the 13th century Italian Renaissance goldsmiths, and the 14th century goldsmiths continued it. The process consisted of sculptured work in low relief on the metallic base and the filling in of the uneven surface with colored translucent enamels. Flesh parts are either colorless or of weak violet enamel. Noted enamelers in this style were Andre Ognobene (antependium in San Giacomo at Pistoja); Andrea Arditi (life-size bust of Saint Zanobi in Florence Cathedral); Francia, as Forzore; Veri (two reliquaries in Orvieto); Leonardo and Piero (parts of the altar of Pistoja); Braccini (chalice in Pistoja); Nicolo and Enrico Bonaventura (reliquary of the head of Saint Sigismond at Sienna); Pollajuolo (altar cross and pax in Florence); Finiguerra, the artist. The same style was practised in France in the reign of François Premier, but the Limoges enamelers soon suppressed it. We find in this style extant a monstrance in the cathedral treasury at Aix-la-Chapelle, dated 13th century, and two reliquaries in the form of chapels with translucent enamel windows; in Cologne Cathedral treasury is a superb cross in this style.

Émaux Peints.— This style is similar to ordinary painting, the canvas being represented by a surface of enamel and enamel colors substituting oil colors. Its origin is in doubt. We first know of it as done in Limoges in the second half of the 15th century. The oldest known piece extant is a reliquary in the chapel of Saint Sulpice-les-Feuilles at Bourganeuf; arrived there 1479. One process was to engrave an outline on the copper with an etching needle, cover thinly with translucent enamel, then trace the outlines in dark enamel. These lines formed the border for the other colors. The technique changed in the 16th century, when painting in white was done on a thick coat of black or dark enamel. Thin layers of white formed the half-lights, heavy layers produced the lights; hatching the thick layers with a point sometimes produced the shading. Such manipulation produced the so-called *en grisaille* (gray on gray) style. Flesh parts were generally given a reddish color. Numerous firings were needed. After the beginning of the 16th century the copper received a background of brown, and the painting was done in translucent colors, the flesh parts being in opaque enamels. Limoges painters generally selected biblical subjects or saints till middle of the 16th century. Italian Renaissance decoration then appeared. Rosso and Primaticcio, Italian artists, called to the court of François Premier, made sketches for models, later taking to the work themselves. Plates were no longer the sole pieces, but also vessels and services, dishes, plates, bowls, pitchers, saltcellars, candlesticks, etc. They are found everywhere in collections. Of well-known artists in this style must be mentioned the three Penicauds, Raymond, Leonard, François and Joseph Limosin, the Nouailher family, Courtois (or Courteys) family, Laudin family, H. Poncet, etc. In England Nic. Hilliard (1547–1619) did fine enamel miniatures. In York House, Battersea (London), at Billston and Liverpool, popular enamel painting on copper was done.

"Venetian" Enamels.— This term defined certain dishes, pitchers, etc., in repoussé (embossed) work of the 16th century, generally of Renaissance forms, and entirely coated in enamel.

Enamels of the 17th and 18th Centuries. — In 1632 Jean Toutin, French goldsmith, discovered a process of painting in vitreous opaque colors on gold coated with white, or weakly colored, enamel, then firing. It was like painting on paper with water-colors, in simplicity, as it avoided hatching for shades and coloring with translucent enamels. The process, however, changed the style and enamel painting gave way to miniature painting in enamel pigments. It soon went out of fashion. Toutin and pastel painter Gribelin worked in this style and had many followers decorating vases, watches, rings, with genre scenes, flowers, etc. Noted in this style are Jean Petitot, Georg Strauch, the brothers Peter and Amicus Huot, G. F. Dinglinger, Blesender, Mengs, Boit, van Meytens, Meier, etc.

Émaux en Résille.— A French style of enameling in the 16th century termed thus was done in enamel work. A piece of gold plate with stamped pattern was fitted into a cavity in the glass; the cavity was filled in with translucent enamel which was then fused. The process, whose origin is unknown, was known as *émail en résille*, or *émail en résille sur verre*. Few specimens are extant. One (a crystal bowl with the cipher of Diana of Poitiers) is in the Uffici Palace, Florence; a small oval crystal mirror-back in this style is in the Louvre.

Asiatic Enamels.— From Russia in the 17th century came vessels of cloisonné ware built up of rather heavy wire and with insufficient enamel to reach the upper surface of the wire. Designs are in Byzantine style. Chinese old enamels are greatly prized by collectors; pieces of the Ming dynasty (1368–1644) show perfection of workmanship, harmony of color and beauty of design. They are all champlevé. The Japanese are past-masters in the art of enamel work. Their artists are often representatives of enamel workers of successive generations of the same family for hundreds of years. They do cloisonné work on iron as well as copper and gold. The East Indian is unrivaled in the delicate class of gorgeous champlevé work in arabesque designs of elaborate elegance. The workers of Jeypore, Delhi, Lahore, Benares, Lucknow, are in a class by themselves, and their expert knowledge of the art dates back very far, as pieces extant show.

Modern Enamels.— While most of our modern enamel wares are derived from the sources above mentioned, France has its Lalique and Thesmar; England its Thomas Fisher, whose work is considered fit for exhibition in the Victoria and Albert Museum. George Frampton, R.A., and Mrs. Traquair (Edinburgh) are talented enamelers.

Enamel work is done on glass for windows of churches, also on show pieces of crystal

1 Benvenuto Cellini — Cup of gold and enamel called the Rospigliosi Coupe
2 Limoges Enamel French, 1495–1520 Nardon Penicaud — Triptych. Annunciation, Birth of Christ, Circumcision

ware, such as goblets, etc., and on modern table glass *de luxe*. See GLASS.

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CLEMENT W. COUMBE.

ART GALLERIES, primarily buildings or rooms dedicated to art and used for the exhibition of works of art; hence, secondarily, important public or semi-public collections of art objects. In ancient Athens the marble hall that formed the north wing of the Propylæa contained works of celebrated painters and was called the Pinacotheca, gallery of pictures. But in Rome, at the time of Augustus, a wholly different plan was adopted. The design of Augustus and his successors was not to assemble works of art in a single great building, or a number of such buildings devoted exclusively to that use; rather it was to make Rome itself a true Pinacotheca, and to give the utmost publicity to both paintings and statues by placing them where they would be seen of all men, in porticos, along the promenades, and wherever public meetings were customarily held. Thus even the Roman Forum was brilliant with paintings, and the porticos of Philip, Octavia and Pompey were literally covered with them. Later, when Constantine made Byzantium the imperial capital and assembled there from all parts meritorious statues and paintings, "the idea did not occur to him," as has been well said, "to shut them up in a single locality; he made them serve for the decoration of various edifices and promenades of the city," which thus became, as Rome had been, one immense museum of art. During the Middle Ages, when art sought ecclesiastical protection, the churches were the only museums of sculpture and painting; but toward the close of that period kings and nobles, as well as powerful ecclesiastics, formed collections which eventually became nuclei of many of the great public European art galleries of the present day. In this sense the collections of the Medici family became the art galleries of Florence; the collections of the Popes constituted the Vatican galleries; the Farnese collection was the starting-point of the Studj at Naples; and it is well known that the Louvre embraces collections of several other sovereigns beside those of Francis I and Louis XIV.

Now, although it may be truly said that, so long as they remained princely or royal properties, these galleries were as a rule opened freely to artists, we must bear in mind the vicissitudes to which they were exposed. The privilege of visiting them might be withdrawn by their owners at any time. Morever a political revolution might occasion their dispersal — the fate that actually overtook the magnificent collection of King Charles I of England. It was only after the French Revolution that art galleries and museums became to such an extent genuinely public institutions that, although still in certain countries dependent upon the power of the Crown, the collections were at least inalienable and not subject to important modifications without the consent of the representatives of the nation; and, as we shall presently note, this change was accompanied by a partial return to the old Roman ideals of publicity, accessibility, utility. Toward the end of the 18th century France set an example to other countries, making the Louvre the first truly national art-institution in Europe. Together with the less important art galleries or art museums of the French capital and provinces, the Louvre became absolutely the nation's property, and as such open to all; and soon the observation was made that not alone artists, tourists and cultivated persons of the leisure class visited the democratized galleries, but that they rapidly grew to be favorite «places of pilgrimage» for the laboring class; that they were becoming higher schools of industry, so to speak, and in this way rendered much practical service to the State. The utilitarian influence of the art galleries of Paris was so thoroughly appreciated that many departmental institutions of a similar character were established, such as those of Dijon, Lyons, Bordeaux, Marseilles, Toulouse, Orleans, Rouen, Avignon, Arras and Grenoble.

Observation of the satisfactory French experience in connection with the democratization of art galleries had four results in other lands: (1) It popularized the theory that art-education must, so far as possible, be provided for all the people; (2) the number of art galleries was greatly increased; (3) systematic efforts were made to utilize such galleries for the promotion of artistry in every form; and (4) galleries and museums of art began to extend their good offices far beyond their walls. They are at present concerned not only with the persons who may come to them seeking instruction but also with the study, registration and conservation of objects — the artistic, the historically valuable and the beautiful things in their

neighborhood. Mr. Benjamin Ives Gilman, secretary of the Museum of Fine Arts, Boston, writes: "Let each American museum of art take its neighborhood for its province, acquiring and imparting information about any local works of art, public or private, whose owners may offer them for the purpose. A knowledge of what we have is the necessary and often sufficient condition of its preservation." This excellent program expressly includes the accurate and complete registry, by description, measurement, photography and otherwise, of such buildings, monuments, paintings, sculptures, etc., in the locality as the officers of the museum may consider of public interest from an artistic point of view; and this may be taken as the last word, up to 1917, in regard to the extension of any art gallery's or art museum's influence beyond its own walls.

But even more noteworthy than such extra-mural activity is the intra-mural; and here the most important subjects are the following: (1) The advanced thought of the day in regard to the adequate installation and exhibition of objects of art, especially paintings; and (2) the development of educational features. As for the first of these subjects, the best usage at present authorizes the propositions that the several collections or groups in a large gallery or museum of art should be arranged in chronological order, to bring out the historical, as well as the æsthetic, relationships; but that, within each of the large groups, the purely æsthetic arrangement should be preferred to the chronological. The effect of this is, that a visitor can observe and study the history of art, from the earliest times to our own day, simply by making intelligent use of his eyes in one gallery after another, taking the rooms or galleries in the prescribed sequence and consulting such catalogues as will give in compact form the last word in competent connoisseurship. That ideal may not indeed be fully realized, but that it shall be approximated is clearly the purpose of the most enlightened and progressive art directors.

In order to appreciate the value of the principle involved, let us note its application to the arrangement and display of paintings only, rather than to the entire museum with all its collections, embracing architecture, sculpture, etc., as well as the pictures. The advanced thought in regard to adequate installation and exhibition of paintings is that we should do our best to make it convenient for visitors to look at them in the way it was intended (by their makers) they should be looked at — not contenting ourselves with merely having them numbered or labeled and hung in serried rows in a gallery no better suited to the purpose than are some of the European art galleries and museums. A distinguished art expert writes that the public collections of Europe seem to put every possible or conceivable obstacle in the way of our enjoyment. He believes that each masterpiece should be isolated in a special niche like the image of a jealous god, and he complains that, on the contrary, it is often stuck like a postage stamp on a wall covered with paintings that have little or nothing but archæological interest to recommend them. Another art critic, looking backward to the times when altar-pieces and easel-pictures (now in our galleries) were visible in the very places for which their painters had designed them — and therefore in their own sympathetic surroundings — manifests an art-lover's longing for the restoration of surroundings that might at least be suitable, although, naturally, never again quite the same. Progressives who hold that it is not practicable to isolate every masterpiece in a special niche, nevertheless advocate the construction of galleries with wall-space so ample that even those pictures which lack something of the superlative quality we revere in the greatest masterpieces need not be crowded together; since it is very difficult to appreciate fully any single painting when others in the same field of vision compete with it for our attention. Summarizing the conclusions reached by authorities in this field, we may say that, for the better enjoyment of all the oldest paintings, it is desired to reproduce, so far as practicable, such surroundings as they had originally. With only a small collection, this certainly can be done; how far, then, can such a principle of reform apply to large galleries? Admittedly it is possible to achieve, even with very large collections, vastly better results in the future than any to which we have hitherto attained. It is well understood that eventually the reform must be thorough going; that, for example, a systematized collection of paintings in the midst of unorganized collections of architectural and sculptural examples could never produce its proper effect. It must be a part of the harmonious development that shall prevail in every part of the art gallery of the future.

In America every important public collection of art objects is regarded as a part of the educational system; and this view has been both qualified and explained in the following terms: "The main preceptor must always be one's own eye, and the way to cultivate its powers must always be to use them. This means that, as conditions are in our country today, almost all valid training in the appreciation of art must be gained in the public museum or gallery. And it follows that in all possible ways the museum, the gallery, should itself facilitate, stimulate, and guide the self-education of the people." And fortunately it is permissible to add that the more progressive galleries or museums of art "are working out schemes of various kinds for the definite instruction of the public. Study-rooms devoted to one branch of art or another, handbooks and special treatises, illustrated lectures delivered in the museum or elsewhere, tours of the galleries under guidance, loan collections sent to various parts of the city — these are some of the methods that they adopt, always with the conviction that true teaching means advising the eye how to educate itself and therefore always with the aid of the museum collections. It is our museums themselves that have started this novel work," which has already been endorsed and facilitated by schools and colleges and by National, State, and municipal authorities, and is winning the support of many others who care for education and who care for art. Consult Wilcox, M., in *The International Studio*, July 1917, p. xxii, and Van Rensselaer, M. G., *ibid*, p. 2; also Jackson, M. T., 'The Museum' (London 1917).

Here follows a selected list of art galleries and museums in various parts of the world:

UNITED STATES AND CANADA.

ALBANY, N. Y.— Albany Institute and Historical and Art Society.
BALTIMORE, MD.— Walters Gallery.
BOSTON, MASS.— Museum of Fine Arts.
BUFFALO, N. Y.— Albright Art Gallery.
CHICAGO, ILL.— Art Institute of Chicago.
CINCINNATI, OHIO.— The Cincinnati Museum Association.
CLEVELAND, OHIO.— The Cleveland Museum of Art.
DETROIT, MICH.— The Detroit Museum of Art,
HARTFORD, CONN. — Wadsworth Atheneum and Morgan Memorial.
MILWAUKEE, WIS.— Layton Art Gallery.
MINNEAPOLIS, MINN.— The Minneapolis Institute of Arts.
MONTREAL, CANADA.— Montreal Art Gallery.
NEW HAVEN, CONN.— Yale School of Fine Arts (Jarvis Collection, Trumbull Collection, etc.).
NEW ORLEANS, LA.— Delgado Museum of Art.
NEW YORK CITY, N. Y.— Brooklyn Institute of Arts and Sciences; Hispanic Society of America; Historical Society; Metropolitan Museum of Art; Public Library (paintings and prints department).
OTTAWA, CANADA.— The National Gallery of Canada.
PHILADELPHIA, PA.— Pennsylvania Academy of the Fine Arts; Pennsylvania Museum and School of Industrial Art; Wilstach Gallery.
PITTSBURGH, PA.— Carnegie Institute.
PRINCETON, N. J.— Museum of Historic Art of Princeton University.
PROVIDENCE, R. I.— Rhode Island School of Design.
QUEBEC, CANADA.— Museum of the Université Laval.
ROCHESTER, N. Y.— Memorial Art Gallery.
ST. LOUIS, MO.— City Art Museum.
SAN FRANCISCO, CAL.— The San Francisco Art Association.
SYRACUSE, N. Y.— The Syracuse Museum of Fine Arts.
TOLEDO, OHIO.— The Toledo Museum of Art.
TORONTO, CANADA.— Toronto Museum of Art ("The Grange").
WASHINGTON, D. C.— Corcoran Gallery of Art; National Gallery of Art.
WINNIPEG, CANADA.— Museum of Fine Arts.
WORCESTER, MASS.— The Worcester Art Museum.

LATIN AMERICA

BUENOS AIRES, ARGENTINA.— Museo Nacional de Bellas Artes.
CARÁCAS, VENEZUELA.— Academia de Bellas Artes.
KINGSTON, JAMAICA.— Jamaica History Gallery.
LIMA, PERU.— Gallery of Paintings in the Museo de Historia Natural, Palacio de la Exposicion.
MEXICO CITY, MEXICO.— Museo de Arte de Academia de Ciencias.
MONTEVIDEO, URUGUAY.— Museo Nacional de Bellas Artes.
RIO DE JANEIRO, BRAZIL.— Escola Nacional de Bellas Artes.
SANTIAGO, CHILE.— Museo de Bellas Artes.

EUROPE, AUSTRALIA, AFRICA AND ASIA

AUSTRALIA.— National Gallery at Melbourne.
AUSTRIA.— Art-history Museum, Gallery of Paintings and Liechtenstein Gallery, Vienna.
BELGIUM.— Galleries of old and modern pictures in the Royal Museums, Brussels.
CHINA.— Peking Imperial Museum in Peking.
DENMARK.— Art Museum at Copenhagen.
EGYPT.— Graeco-Roman Museum at Alexandria, and Museum of Egyptian Antiquities and National Museum of Arab Art at Cairo.
FRANCE.— Louvre, Musée du Luxembourg and Musée de Cluny, at Paris, and Musée National at Versailles. Musées des Departments that have shown positive evidence of growth during the last quarter of a century are those of Amiens, Abbeville, Boulogne-sur-mer, Clarmont Douai, Lille, Poitiers, Saint-Quentin, Senlis and Valenciennes.
GERMANY.— Old and New Museums and National Gallery at Berlin, the Royal Gallery of Paintings at Dresden, and the Glyptothek and the Old and New Pinakothek at Munich.
GREAT BRITAIN.— Museum and Art Gallery at Birmingham, the National Gallery and the Municipal Gallery of Modern Art at Dublin, the National Gallery of Scotland at Edinburgh, the Art Gallery and Museum at Glasgow, the Walker Art Gallery at Liverpool, the Ruskin Museum at Sheffield, and the following in London: National Gallery, National Portrait Gallery, National Gallery of British Art (formerly the Tate,) Victoria and Albert Museum (formerly South Kensington Museum), British Museum, and Wallace Collection.
GREECE.— National Museum at Athens.
HOLLAND.— Koninklyk Kabinet van Schilderyen and Municipal Museum at The Hague and Museum-Boijmans at Rotterdam.
INDIA.— The Indian Museum at Calcutta.
ITALY.— The Accademia di Belli Arti, the Uffizi, the Pitti Palace and the Bargello, at Florence, the Brera at Milan, the Museo Nasionale at Naples, the Vatican, the Capitoline, the Borghese and the Doria at Rome, and the Accademia di Belli Arti at Venice.
JAPAN.— The Imperial Museums in Tokio, in Kioto, and in Nara.
KOREA.— The Korean Museum in Keijo.
NORWAY.— The Statens Museum of Art (Nationalgalleriet) at Christiania.
PORTUGAL.— Museu Nacional de Arte Antiga and Museu Nacional de Arte Contemporanea at Lisbon.
RUSSIA.— The Hermitage and the Russian Museum of Alexander III at Petrograd.
SPAIN.— Museo del Prado and Academia de Bellas Artes at Madrid, the Casa Greca at Toledo, and the Palacio de Bellas Artes at Barcelona.
SWEDEN.— National Museum at Stockholm.
SWITZERLAND.— Picture Gallery at Basle.

MARRION WILCOX.

ART, Metropolitan Museum of, New York city, one of the famous art institutions of the world, situated in Central Park, on the east side, and extending between 80th and 85th streets on Fifth avenue, in grounds covering 18½ acres. The first portion of the building facing south in Central Park, was opened in March 1880, and with subsequent additions, south (1888), north (1894), the ornate east extensions on Fifth avenue designed by Richard Morris Hunt, opened in 1902 and 1908, and further extensions provided for, represent an outlay of about $20,000,000, which was authorized in various appropriations by the State legislature. Among the priceless treasures of the museum, which include the munificent Morgan, Vanderbilt, Wolfe, Altman, Hearn and Marquand bequests, are the varied collections of paintings of Dutch, Flemish, Italian, French, English and American schools; collections of sculpture and architecture, ancient and modern, including Greek and Roman marbles and bronzes, modern French, American and other statuary; casts and replicas of famous pieces, etc.; Assyrian, Babylonian, Egyptian, Phœnician, Cypriote and Etruscan antiquities — the Cesnola collection of Cyprian antiquities acquired in 1870 for $60,000, the Babylonian cylinders, Egyptian mummies and cases, and an Etruscan bronze chariot of the 6th century B.C., being unrivalled in the world. Decorative arts are also exhaustively represented and comprise the Dino and Ellis and the Riggs collections of mediæval arms and armor; the Avery collection of spoons; the Lazarus collection of fans; collections of laces, European textile fabrics; European ceramics, including the Le Breton collection of French faïence; the Crosby-Brown collection of musical instruments; woodwork and furniture including the Hoentschel collection of 18th century French decorative arts; collection of ormolu; Heber-Bishop collection of jade; Germanic and Merovingian antiquities; and collections of wood-work, metal-work, ceramics and textiles, representative of China, Japan, Persia and Asia Minor. Special attention is also given to American decorative arts. The inception of the museum dates from 1869 and a public meeting at which a committee composed of members of the National Academy of Designs and generous art patrons, organized to raise an endowment of $250,000 and outlined the plan which received a charter of incorporation 13 April 1870. The corporation now numbers over 3,100 fellows and members rated according to the amount of their annual contributions. A board of trustees elected from the fellows governs the museum, which is ad-

ministered by a director and regular staff. While the ground and buildings are public property, the additions to the museum and cost of administration (in a recent year over $461,500) with the exception of the city's annual contribution of $200,000, are covered by gifts and an endowment created by rich benefactions. Among the chief benefactors of the museum have been its presidents, John Taylor Johnson, Henry Marquand and J. Pierpont Morgan; Miss Catharine Lorillard Wolfe who besides her collection of paintings donated $200,000; Jacob H. Rogers (1901), $6,000,000; John S. Kennedy (1909), $2,500,000; Francis L. Leland (1912), $1,000,000; Frederick T. Hewitt, $1,600,000 and Mrs. Morris K. Jesup (1915), $200,000 with a collection of paintings. The directors of the museum have been Gen. L. P. di Cesnola (1879–1904); Sir Caspar Purdon Clarke (1905–10) and Edward Robinson (1910–). Mr. Robert W. De Forest was elected president after Mr. J. Pierpont Morgan's death in 1913. The total attendance of visitors to the museum during 1915 was 913,320.

ART OF POETRY, The ('Ars Poetica'). a famous work by Horace. This is not the name given it by its author, who called it merely a 'Letter to the Pisos.' Horace treats of the unity that is essential to every composition, and the harmonious combination of the several parts, without which there can be no lasting success. In the second part, the poet confines himself to the form of the drama, the principles he has already established being so general that they apply to every class of composition. See HORACE.

ART OF WAR. The art of war may be conveniently subdivided into the following sections: (a) The organization of armies; (b) logistics; (c) strategy; (d) engineering; (e) tactics. The organization of armies is the building up necessary for the application of the principles of strategy to them. Logistics is the art of moving and supplying armies. Strategy is the art of directing armies upon the theatre of war. Engineering is the art of disposing troops and making arrangements of obstacles by means of which an inferior force may successfully resist the attacks of a superior force; and also the art of overcoming and removing all obstacles placed in the way by an opposing force. The following are the duties of engineers of an army: the construction and maintenance of field-telegraphs, the construction of fortifications, the conduct of engineering operations at sieges, mining, bridging, surveying, reconnoitering, opening and making roads, choosing positions, sketching ground, etc. Tactics is the art of putting into execution the projects of strategy. An intimate knowledge of all these branches is absolutely necessary in order to be a great and successful general. The formation of a plan, that is, deciding the nature of the war that will be waged; determining the objects to be attained, and the best manner and means of attaining them; or, in other words, outlining the general features of a campaign, belongs to strategy. The execution of the plan decided upon belongs to tactics. The country in which the opposing armies can come into collision is the province of battle. The principles of war cannot be violated with impunity. These principles are fixed and are determined from the narrative of operations conducted by successful generals. A study of military history is then necessary for a proper understanding of the principles of war; and as in all other professions, so in war, he who is most proficient in the lessons as taught by the masters of the art will be most successful.

The duties of each arm of the service overlap and blend into one another, and the higher the grade an officer attains, the more requisite it is that he should be acquainted generally with the duties of those arms of the service to which he himself does not belong. By this means alone can we hope to obtain that intelligent cooperation, that harmonious working of all branches of the service together, which makes a perfect machine out of the various elements comprising an army, and at the same time gives the surest guarantee of success. In armies, as elsewhere, there is a tendency for every one to think his own branch, that which he has studied most and knows best, the most important. Such feelings are very natural and in the lower grades often do much good; but as men rise in the service it is desirable that they should know something of the duties of other branches, and the difficulties others have to contend with. Such knowledge tends to produce cordiality and forbearance. Cavalry officers falling into command of mixed forces will not then expect their infantry to gallop; infantry officers will not seek to bind the cavalry to pace of their infantry. A knowledge of capabilities of other arms will enable officers to use those arms to the best advantage as occasion offers. It should, however, be borne in mind that it is impossible to lay down fixed rules of action. Nearly every military regulation should be followed by the words "according to the ground and according to the circumstances." Practice and experience alone can decide many points; practice and experience alone can give the power of applying rules; but theory, by which is really meant the experience obtained by others, is not the less important and valuable. Principles are but guides, which must be revised, examined and verified after each war, after each discovery that may be brought to bear on the military art. See ARMY ADMINISTRATION; ARMY REGULATIONS; ARMY TRANSPORTATIONS; ARTILLERY; BALLISTICS; CAVALRY; ENGINEERING, MILITARY; GUNNERY; MILITARY EDUCATION; TACTICS.

ART STUDENTS' LEAGUE OF NEW YORK, an important art school, at 215 West 57th street, New York city. It was founded in 1875 by a number of students of the National Academy of Design dissatisfied with the conventions of the older schools. The school is entirely self-supporting, being maintained from the fees of its students, which range from $30 to $70. The membership has grown steadily until now it is over 1,500, while the average number of pupils is about 500. The courses include drawing, antique drawing, composition, still life and miniature painting, modeling, painting from life, illustration, anatomy and study of the theory and history of art. Night classes and a summer term are also among its features. During the summer a course in landscape painting is given at Woodstock, Ulster County, N. Y. There are practically no entrance requirements. The government of

the institution is vested in a board of control, elected by the members, themselves elected from the advanced students. Among the prizes awarded are, the $100 prize, for the best painting, the Saltus Prize, $50, for antique drawing, the Saint-Gaudens Prize, $75, for figure modeling, the Saint-Gaudens Prize, $25, for composition modeling and the Evans Prize, $50, for applied art.

ARTA, är'tą, the name of a gulf, town, and river. The gulf (ancient *Ambracius Sinus*), an arm of the Ionian Sea, between Greece and Albania, is about 20 miles long by 10 miles broad. Near its entrance the battle of Actium was fought. The town, called also Narda (the ancient *Ambracia*), about six miles north of the gulf, stands on the river, which is here about 200 yards wide, and begins to be navigable. It carries on a considerable trade in wine, oranges and tobacco. Pop. 8,600.

ARTABANUS IV, the last of the Parthian monarchs, who 217 A.D., escaping with great difficulty from a perfidious massacre begun by the Romans under Caracalla, mustered an army, and engaged his foes in a battle which lasted for two days. Peace was then concluded, but Artabanus afterward incited his subjects to revolt, and in a battle, in 226, was captured and put to death.

ARTABAZUS, the name of several distinguished Persians under the dynasty of the Achæmenidæ. An Artabazus led the Parthians and Chorasmians against Xerxes. Another Artabazus, a general under the Persian King, Artaxerxes II, afterward revolted against Artaxerxes III. He was forgiven through the exertions of his brother-in-law, Mentor, a favorite and staunch supporter of the next king, Darius, whom Artabazus faithfully attended after the battle of Arbela. Alexander rewarded his loyalty by making him satrap of Bactria.

ARTAGNAN d', där'tą-nyän', the hero of Dumas' 'Trois Mousquetaires,' 'Vingt ans après,' and 'Le Vicomte de Bragelonne.' He is a Gascon adventurer, very popular among heroes of romance. There was, however, a Count d' Artagnan (b. about 1612; d. 1673), who was an officer of musketeers, and fell in the siege of Maestricht.

ARTASIRES, the last Arsacid monarch of Armenia. He was placed on the throne by Bahram V of Persia, who afterward deposed him and annexed his dominions to Persia, under the name of Persarmenia, 248 B.C.

ARTAVASDES, är'ta-väs'dēz, **I,** a king of Armenia, who succeeded his father Tigranes. He joined the Roman forces commanded by Crassus, but deserting to the enemy, caused the defeat of the Romans, and the death of Crassus. He similarly betrayed Mark Antony when engaged against the Medes; but afterward falling into Antony's power, was taken with his wife and children to Alexandria, where they were dragged at the victor's chariot wheels in golden chains. After the battle of Actium, Cleopatra caused his head to be struck off and sent to the King of Media.

ARTAXATA, the name of the ancient capital of Armenia, the refuge of Hannibal when forsaken by Antiochus. Its ruins are now known as Ardashir.

ARTAXERXES, är'täks-ėrks'ēz, the name of several Persian kings: (1) ARTAXERXES I, surnamed LONGIMANUS, because his right hand was longer than his left, the second son of Xerxes, escaped from Artabanus and the other conspirators who had murdered his father and elder brother Darius, and in 465 B.C. ascended the throne. He conquered the rebellious Egyptians, terminated the war with Athens by granting freedom to the Greek cities of Asia, governed his subjects in peace, and died 425 B.C. (2) ARTAXERXES II, surnamed MNEMON, from his strong memory, succeeded his father, Darius II, in the year 405 B.C. After vanquishing his brother Cyrus he made war on the Spartans, and forced them to abandon the Greek cities and islands of Asia to the Persians. He favored the Athenians, and endeavored to foment dissensions among the Greeks. His last days were embittered by the unnatural conduct of his son Ochus, who, to secure the crown to himself, caused the destruction of two of his brothers. On the death of Artaxerxes Mnemon, 359 B.C., Ochus ascended the throne under the name of (3) ARTAXERXES OCHUS. After having subdued the Phœnicians and Egyptians, and displayed great cruelty in both Egypt and Phœnicia, he was poisoned in 339 B.C. by his general, Bagoas. (4) ARTAXERXES BEBEGAN was the first King of Persia of the race of Sassanides. He was a shepherd's son; but his grandfather, by the mother's side, being governor of a province, he was sent to the court of King Ardavan. On his grandfather's death, Artaxerxes, exciting the people to revolt, defeated and slew Ardavan and his son, and assumed the title of King of Kings. He made vast conquests, and wisely administered the affairs of his kingdom.

ARTEDI, är-tā'dē, **Peter,** an eminent Swedish naturalist: b. Anund, 22 Feb. 1705; d. Amsterdam, Holland, 27 Sept. 1735. He went in 1724 to Upsala to study theology, and turning his attention to natural history, soon rose to considerable eminence, particularly in the department of ichthyology, the classification of which he reformed on philosophical principles. This arrangement added greatly to his reputation as a naturalist at the time, and afterward he became popular over Europe. Four years later Linnæus (q.v.) arrived in Upsala, and a life-long friendship grew between the two men. In 1732 both left Upsala — Artedi for England, in pursuit of his favorite study; and Linnæus for Lapland, to examine its natural productions; but before parting they reciprocally bequeathed to each other their manuscripts and books upon the event of death. According to agreement his manuscripts came into the hands of Linnæus, and his 'Bibliotheca Ichthyologica' and 'Philosophia Ichthyologica,' together with a life of the author, were published at Leyden in the year 1738. Linnæus named a genus of umbelliferous plants Artedia, in memory of his friend.

ARTEMIA. See BRINE-SHRIMP.

ARTEMIDORUS, a Greek geographer: b. in Ephesus, who flourished about 100 B.C. His 'Geographoumena' in clever books was an exhaustive work on the various features, geographical, physical, historical and political, of the larger part of the then known world, founded on the writer's own investigations and the work of preceding writers. Only fragments of his work are extant.

ARTEMIS, a Greek goddess, identified with the Roman Diana. She was the daughter of Zeus (Jupiter) and Leto or Latona, and was the twin sister of Apollo, born in the island of Delos. She is variously represented as a huntress, with bow and arrows; as a goddess of the nymphs, in a chariot drawn by four stags; and as the moon goddess, with the crescent above her forehead. She was a maiden divinity, demanding the strictest chastity from her worshippers, and is represented as having changed Actæon into a stag, and caused him to be torn in pieces by his own dogs, because he had secretly watched her as she was bathing. The Artemisia was a festival celebrated in her honor at Delphi. The famous temple of Artemis at Ephesus was considered one of the wonders of the world, but the goddess worshipped there was very different from the huntress goddess of Greece, being of Eastern origin, and regarded as the symbol of fruitful nature.

ARTEMISIA, a genus of aromatic, herbaceous or shrubby plants of the family *Asteraceæ,* consisting of about 250 species, natives of temperate or subarctic regions. *A. dracunculus* is tarragon or estragon, the leaves of which are used for seasoning. *A. absinthium,* wormwood, is the source of absinthe and is also used medicinally. *A. abrotanum,* southernwood, and *A. stelleriano,* old woman, are cultivated as ornamental plants. *A. tridentata* is the common sagebrush of the plains of the western United States, being the most common and characteristic plant over many thousands of square miles.

ARTEMISIA I, är'tę-mĭzh'i-ą, or mĭsh-ĭ-ă, a queen of Caria, who lived in the 5th century B.C., and assisted Xerxes in person against the Greeks, and behaved with such valor that the Athenians offered a reward for her capture, and the Spartans erected a statue to her.

ARTEMISIA II, a queen of Caria, who flourished about 350 B.C. She was the sister and wife of Mausolus, whose death she lamented deeply, and to whom she erected, in her capital, Halicarnassus, a monument reckoned among the seven wonders of the world. The principal architects of Greece labored on it. Bryaxis, Scopas, Leochares and Timotheus made the decorations on the four sides of the edifice; Pythes, the chariot drawn by four horses, which adorned the conical top. Vitruvius thought that Praxiteles was also employed on it. After the death of Artemisia the artists finished it without compensation, that they might not be deprived of the honor of their labor. It was an oblong square, 411 feet in compass, and 130 feet high. The principal side was adorned with 36 columns, and 24 steps led to the entrance. From the tomb of Mausolus is derived the word "mausoleum."

ARTEMISIUM, är-te-mĭsh-ĭ-um, a promontory in Eubœa, an island of the Ægean, near which a great naval battle between the Greeks and Persians was fought, 480 B.C. It was named from a temple to Artemis situated here.

ARTEMUS WARD. See BROWNE, CHARLES FARRAR.

ARTERIAL PRESSURE. See BLOOD PRESSURE.

ARTERIES are the elastic tubes or vessels that carry blood from the heart to the tissues of the body. They owe their name, which was connected by the older anatomists with the Greek *aer,* air, to the belief that they contained air, since they were found empty after death. The arteries spring from the heart in two great trunks, the pulmonary artery which carries blood to the lungs, and the aorta through which the blood is sent throughout the body. Each of these two main trunks divides and redivides until they become the minute vessels known as arterioles. Arteries show a ready adaptation in change of position attendant upon evolutionary development or mechanical obstruction in the individual organism. The main trunks occupy relatively constant positions but as the branches become smaller and smaller their position is less constantly determined. As they approach the periphery of any organ their minute branches connect through the hair-like capillaries with the minute divisions of the veins, which carry the blood back to the heart, thus completing the round of the circulation. The carotid is the branch of the aorta which mainly supplies the blood to the head, the superficial or external carotid supplying the outer structures and the deep or internal carotid nourishing the brain and deeper lying parts. There are numerous anastomoses between the branches of the carotid arteries. The most important of these form a vascular circle, the *circle of Willis,* which affords freedom of arterial circulation by the anastomoses between arteries not only on the same side but also on opposite sides of the medial plane. For the other main branches of the aorta see AORTA.

The minute structure of the arteries is well adapted to the varying functions that these vessels perform. Their walls consist of several coats. The outer coat, or the *tunica adventitia* is composed of white, fibrous connective tissue. Next to this is the *yellow elastic* and within this the *muscular coat* composed of involuntary muscular tissue. The elastic coat is much thicker in the large arteries than the muscular but in the smaller there is a relatively stronger muscular coat. In the first part of the aorta, pulmonary artery, and arteries of the retina there is no muscular coat. The vasomotor nerves terminate in the muscular coat. Within this layer is a smooth elastic coat perforated by small apertures. The innermost coat is a layer of endothelial cells which forms the free surface over which the blood flows with a minimum of friction. The extreme toughness of the outer layer strengthens and protects while the elasticity with which the walls are provided permits the artery to return to its average diameter after it has been contracted or dilated by the muscular layer. The large arteries are thus more elastic and less contractile while for the smaller ones the reverse is true. The arteries are nourished by their own blood supply through minute vessels, *vasa vasorum,* distributed through the fibrous, elastic and muscular coats.

SMITH ELY JELLIFFE.

ARTERIES, Diseases of. The arteries are subject to a number of diseases which may be classed as (1) due to infectious micro-organisms, (2) degenerations with increase of connective tissue, (3) aneurisms, (4) inflammation due to injury or extension of inflammation from surrounding parts, (5) "Fatty Degenera-

tion" i.e., fat replacing some of the elastic muscular and connective tissue and so interfering with arterial functions. Of the acute infectious diseases, tuberculosis and syphilis, particularly the latter, are important. Syphilis is one of the most important causes of arterial degeneration. *Acute arteritis* is a definite disease, although the great pathologist, Virchow, taught that it was a secondary affection. Recent bacteriological studies, however, have shown that bacterial infection of the arterial walls is a fundamental and important process. It is frequently the cause of an arterial thrombus and often develops into a true arteriosclerosis or hardening of arteries. Hardening occurring in large arteries is known as *atheroma*. See ARTERIOSCLEROSIS.

ARTERIOSCLEROSIS. The term Arteriosclerosis or "hardening of the arteries" seems an inappropriate one (though hardening of these vessels is mainly noticed) for the condition is usually associated with heart and kidney disease. Hence, some writers use instead, the terms "Cardiovascular" or "Cardio-vascular — venal disease." There is reason to believe that the disease is in reality a general one due primarily to a "disturbance of metabolism" or a disturbance of the relation of certain material which comes from the food for the nourishment and health of the cells of the body. Then the liver, spleen, thyroid gland, supra-venal glands and other metabolic function organs are affected, and the involvement of other organs is a matter of sequence. Hardening of the arteries is a very important diseased condition. Though found in the young it is usually a disease of advanced life, and prevails especially among the so-called "comfortable classes." It interferes with the proper supply of blood to various organs, principally the heart, kidneys and brain and may cause actual disease — filro-myocarditis, nephritis and a weakened condition of the arterioles of the brain, which very readily results in cerebral hæmorrhage, one of the forms of apoplexy. The various steps in the production of arteriosclerosis are often — an acute illness or severe nervous shock, defective metabolism, organs concerned in metabolism don't act properly, kidneys become sclerotic and do not eliminate waste products, then there is a rise of blood pressure to assist them, so the heart hypertrophies. Then comes an increase in connective tissue of the arteries with hypertrophy of their muscular elements and a thinning or a diffuse or circumscribed thickening of their lining membranes, and if affecting superficial arteries they are recognized as hardened. For there may be sclerosis of internal arteries and none of the superficial. Arteriosclerosis may show irregular patches of a gelatinous character which at a later period become hard, even calcified and cause arteries to become brittle like pipe stems. Among the causes which favor its development are changes in the blood from the infection of syphilis and chronic rheumatism, the excessive use of alcohol, the disturbed metabolism caused by diabetes, gout, Bright's disease, etc., and changes in the blood pressure. Arteriosclerosis is maintained and even caused by an over-indulgence of the appetites, and a sluggish mind and body as well as by the wear and tear of modern life, the struggle for wealth and position and by excessive and prolonged muscular exertion and intense emotional activity, especially in middle and later life.

Arteriosclerosis, even if there is a tendency to inheritance, can frequently be checked by *real* temperance and moderation in all things, food and drink, work and play and emotional excitement. While medicines are necessary for special conditions, the removal from the diet of offending food elements, systematic and appropriate exercise and keeping the intestinal tract clean are the principal remedies. See OLD AGE AND ITS DISEASES.

ARTESIAN (är-tē'zhan) **WELLS,** borings of considerable depth which tap a subterranean stream or sheet of water. The name is derived from Artois (Latin *artesium*), a province in France where the first deep borings in Europe were made. Strictly speaking the term artesian is applicable only to such wells as discharge water at the surface under natural conditions (that is, self-flowing wells), but in America the term is commonly applied to any wells of more than ordinary depth. The United States Geological Survey restricts the term to a well in which the water rises under its own pressure above the point at which it was first encountered, even though it does not flow out at the surface, and this is the sense in which the term is here used. The conditions which determine the presence of artesian water in a region relate to the geological structure of the underlying strata. It is essential in the first place that a pervious stratum be overlaid by an impervious layer. The pervious bed, usually sandstone or sand, serves as a reservoir for the accumulation of water, while the impervious bed prevents this water from escaping. The second requisite is that the strata have a gentle pitch toward the site of the well and that they outcrop at some place above the well. The distance of the outcropping edges, which receive the water supply from rains, is sometimes very great. Owing to friction the water column of the well never reaches the level of the outcropping source. The conditions for artesian water are particularly favorable when the strata are arranged in the form of a geological basin dipping in all directions toward the well, as there then is no opportunity for the water to escape at a lower level. From these considerations it is evident that the discharge from an artesian well depends upon the rainfall of the region and upon the area of the exposed porous stratum. At first the discharge is usually very abundant owing to the long accumulation, and unless this drain is constantly supplied the flow will gradually decrease until a balance is established. When several wells are bored in the same vicinity, the flow from each may be diminished, but the total discharge will increase until the limit of supply is reached. This is well illustrated in the wells bored in the London basin which in 1838 gave a total daily supply of 6,000,000 gallons; in 1851 with a larger number of borings the supply was about doubled, while the force had diminished very markedly; also in Denver, Colo., where some years ago there were many flowing wells which yielded water in large volume and with sufficient head to rise to the upper floors of the buildings. As wells multiplied the head and volume decreased so that in 1916 all wells in the centre of the city had to be pumped and artesian water was available only in the lower

parts of some of the surrounding country. The large area in which flows were obtained in southern California has also been greatly decreased by the heavy draft of water to irrigate orange orchards. Artesian water is valuable not only for domestic use, for which it is usually adapted by its purity, but it is also extensively employed in the irrigation of arid regions. Some parts of the Sahara Desert have been reclaimed by making use of the subterranean stores of water, and recent investigations have shown that there are many areas which may yet be brought under cultivation. It is, however, in the United States that irrigation by artesian waters has reached its greatest development. Special surveys of the Great Plains region have been undertaken by the United States Geological Survey for the purpose of defining the areas where successful borings may be made, and artesian wells are now largely employed for irrigation in South Dakota, New Mexico, Texas, California and Montana. The supply is drawn mostly from the Cretaceous sandstone, which is reached at a depth varying from less than 100 to more than 1,500 feet. When the flow of water is sufficiently strong it may be utilized for power purposes as is done in some parts of Europe and at several points in the Dakotas. In Würtemberg a supply of warm water is applied to the heating of buildings.

The depth at which artesian water may be found depends entirely upon local conditions. In the Paris basin the water-bearing stratum is usually encountered at a depth exceeding 1,500 feet. The famous well at Grenelle, near Paris, was begun in 1833, and operations were continued until 1841 when at a depth of 1,797 feet the water poured out with great force at the rate of 500,000 gallons per day. Another well was sunk near by at Passy, which yielded 5,600,000 gallons daily, the water rising to a height of 54 feet above the mouth. This well was 1,923 feet deep and had the unusual diameter of two feet four inches. A well at Kissingen, Bavaria, furnishes a supply of saline water from a depth of 1,878 feet. Another noted foreign well is that at Schladenbach, near Leipzig, with a depth of 5,735 feet. In the United States there are many notable examples of artesian wells. The first boring of great depth was made at Saint Louis in 1849–54; a flow of 75 gallons per minute was obtained from a depth of 2,200 feet, but the water was so heavily charged with sulphuretted hydrogen and mineral matter as to be unfit for domestic use. Another boring was subsequently made to a depth of 3,843 feet. A well at Louisville, Ky., is 2,086 feet deep and yields 330,000 gallons per day. Among other noteworthy wells are the following: Columbus, O. (2,775 feet); Galveston, Tex., (3,071 feet); Charleston, S. C. (1,250 feet); Pittsburgh, Pa. (4,625 feet); Chicago (710 feet); and Edgemont, S. D., where two wells (2,965 feet each) yield flows of 1,000,000 gallons a day at temperature of 100°. A great many wells have been bored in recent years within the Atlantic Coastal Plain, especially in New Jersey, and many cities have thus obtained supplies of pure water. The temperature of the waters from the average artesian well is from 40° to 50° F., but in the case of very deep wells the water often reaches a temperature of from 70° to 80° F. At Charleston, S. C., there is a well the water from which averages 87° F. The cost of sinking artesian wells varies with the depth and the character of the strata encountered. Up to 500 feet the cost commonly ranges from $1.50 to $3 per foot, but below this limit the cost increases in proportion to the depth. The apparatus used in boring does not differ from that employed in sinking for petroleum. The first artesian borings were probably made by the Chinese. In the upper basin of the Yang-tse-Kiang there are wells 1,500 to 3,000 feet in depth from which brine for salt manufacture is obtained. This industry has been carried on since a very early period and is an illustration of the comparatively advanced state of progress attained by this people long before the western nations had developed the mechanical arts beyond the crude stage. Deep wells have been found also in Egypt which are thought to have been the work of the ancient Egyptians. A well bored in the year 1126 at Lillers, department of Pas-de-Calais, France, is still flowing. For information regarding artesian areas in the United States consult bulletins and annual reports of the United States Geological Survey, and of the geological surveys of several States, particularly those of Iowa, Mississippi, Missouri and New Jersey.

ARTEVELD, är'tĕ-vĕl'dĕ, or **ARTEVELDE,** the name of two men distinguished in the history of the Netherlands. (1) JACOB VAN, a brewer of Ghent, b. about 1290; d. 17 July 1345. He was selected by his fellow townsmen to lead them in their struggles against Count Louis of Flanders. In 1338 he was appointed captain of the forces of Ghent, and for several years exercised a sort of sovereign power. A proposal to make the Black Prince, son of Edward III of England, governor of Flanders, led to an insurrection, in which Arteveld lost his life. (2) PHILIP VAN, son of Jacob: b. 1340; d. 27 Nov. 1382. At the head of the forces of Ghent he gained a great victory over the Count of Flanders, Louis II, and for a time assumed the state of a sovereign prince. His reign proved short-lived. The Count of Flanders returned with a large French force, fully disciplined and skilfully commanded. Arteveld was rash enough to meet them in the open field at Roosebeke, between Courtrai and Ghent, in 1382, and fell with 25,000 Flemings. Consult Ashley, 'James and Philip van Artavelde' (1883); Hutton, 'James van Artavelde' (1882).

ARTEVELDE, Philip van, the title of a tragedy by Sir Henry Taylor, published in 1834. It is one of the best modern English tragedies by an author distinguished for his protest, in the spirit of Wordsworth, against the extreme sentimentalism of Byron. In this play with admirable power he brings back the stress and storm of 14th century life. The father of Philip, the great Jacob van Artevelde, an immensely rich brewer, eloquent and energetic, had played a great part as popular leader at Ghent, 1335–45; and it fell to his son to figure similarly in 1381, but to be slain in a great defeat of the forces of Ghent the next year. Taylor's tragedy recalls the events of these two years.

ARTFUL DODGER, The, the nickname of John Dawkins, a young pickpocket in Dickens' 'Oliver Twist.'

ARTHOIS, är'-twä', **Jacques d'**, Belgian landscape painter: b. Brussels, 1613; d. 1686. Though he studied his art under Jan Mertens, he later became strongly influenced by the Ruebens school. His pictures are mostly of great size and the subjects Biblical, being painted largely for churches and monasteries. He often collaborated with Teniers, Van der Meulen and other noted painters of his time, who painted the figures in his pictures. His color schemes were always rich and virile, but his drawing was sometimes bad. His canvasses are found in nearly all the important galleries of Europe.

ARTHRITIS, an acute or chronic inflammation of the joints, usually due to bacterial infection. Such infection may follow a wound, a perforating injury, an operative incision, or the micro-organisms may come to the joint through the blood stream, as in rheumatism, gonorrhœa, typhoid, or pyemia. In some cases of arthritis the causes seem to be resident in defective metabolism — gout is an illustration of this type of arthritis. In acute cases there are pain, swelling, heat and occasionally suppuration. In the chronic forms the main symptoms are pain and stiffness. The treatment should include rest, counter-irritation, and, in the suppurative cases, prompt surgical attention. In the more chronic cases counter-irritation, dry, hot air, static electricity, and potassium iodide are of service. Sometimes cupping or leeching may be indicated. See ARTHRITIS DEFORMANS; GOUT; JOINTS, DISEASES OF; RHEUMATISM.

ARTHRITIS DEFORMANS (rheumatoid arthritis, or osteo-arthritis), a group of chronic progressive diseases of the joints chiefly affecting the articular cartilages, bones and synovial membranes, and producing loss of function and great deformity from ossification of some parts of the joint and atrophy of others. Their origins are various, some of which are known and some still under investigation, the external appearance of the deformity showing less variation than the internal causes. Thus there are chronic arthropathies which produce the characteristic deformities and result from chronic gonorrhœa of the joints; others follow tonsillar infections, others are related in some way to infections from the teeth. In the majority of the cases there are unconscious mental factors — chiefly, hate reactions — which in some, as yet not perfectly clear manner, have a very definite influence upon the nervous regulation of the bony and joint metabolism, permitting toxic, bacterial, dietetic or climatic factors to have their influence. Though sometimes spoken of as rheumatic gout, they are believed to have little in common with rheumatism or gout, but may coexist with either. This type of disorder is very rare in children, occurs occasionally in old age, is more common between 25 and 50, and in females than in males. In certain of its forms, it most often appears after the menopause, though it may occur earlier, as when following parturition. Heredity plays a part in certain arthropathies which come under this group. In the older descriptions one reads of two theories as to the immediate cause of the affection. For previously the group of different diseases were treated as one disease. The first, the nervous or neuropathic theory, is based upon the symmetrical distribution of the joint-lesions, the trophic changes in the skin, nails, etc., etc., the frequent pre-existing mental disturbances, shock, grief, worry and the like, the disproportionate muscular atrophy, and the similarity of the lesions to those arthropathies of locomotor ataxia and other affections of the spinal cord. The second or infectious theory is derived from the facts that micro-organisms have been found in the fluids and tissues of the joints, that the disease sometimes begins with an acute onset, as do many of the infectious diseases, and that enlargement of the spleen and lymph-glands is found in some cases. It is difficult to say which tissue is primarily at fault but sooner or later nearly all are involved. The synovial membrane inflames and papillary outgrowths and cartilaginous nodules form upon it. These last may undergo fatty degeneration or they may ossify. They may slip into the joint-cavity. If serous effusion occurs it is absorbed early in the disease. The cartilages lose their cells, become fibrillated and soft and are removed by friction and absorption. The ends of the bones (the interarticular cartilages being absorbed) by friction become smooth, rounded and shiny like polished ivory (eburnated). The eburnated surfaces, by attrition, become grooved and minute perforations of the Haversian canals result. Deposits of new bone form around the margins of the joints and may be often felt externally. The muscles atrophy and are of a brownish color. Fibrous adhesions and bony anchylosis occur. Some of the small joints of the fingers for example may move a little, but the knees, etc., may be interlocked by reason of the rims of bony material deposited. Dislocation or subluxation may result. The periosteum along the shafts of the bones may thicken or ossify in nodules. A combined hypothesis which deals with both sets of factors with interplay between is probably nearer the real facts. In certain cases the nervous instability is accompanied by endocrinous — thyroid — deficiency. An acute form of a general or multiple progressive type is rare after 40. Smaller joints become simultaneously painful, tender and swollen but not red as in rheumatism; there is no migration from joint to joint, the affected joints are inflamed, while others are becoming diseased. Patients are anæmic, mentally depressed and complain of headache and malaise. Fever seldom goes above 102° F. Temporary improvement occurs, but the disease advances. The chronic form of this type is insidious and more common. One joint (of finger or toe) is involved; the disease affects the corresponding joint and then other joints; pain may be mild or very severe; there are delusive intervals while the disease marches on. After months, or it may be years, all or nearly all of the joints are thickened, rigid and distorted. The hands are bent toward the ulnar side, fingers strongly flexed, nails in the palms of the hands. The thumbs, though drawn may be used. The knees are generally crossed. The general health through it all may be fair, as visceral lesions are uncommon.

In the monarticular or localized type, the changes are usually confined to one or two

the larger joints, occurs mostly in men and after 50. The knee, shoulder, elbow or hip is generally affected, but the vertebræ may be, the entire spinal column becoming rigid. Motion of affected joints often produces a creaking or grating sound. The pathological appearances are similar to those of the general type of the disease, but joint-injuries are more often an exciting cause. The joint becomes stiff, sore and painful and there is absorption of the ends of the bones, dislocation and deformity.

Heberden's nodes or nodosities, described by him in 1805, are small exostoses ("small hard knobs"), seldom larger than peas, which form on either side of the distal joints of fingers. They may be present in either type of the disease, at first are tender and swollen, but later on apparently cause little discomfort. Sometimes the bone-enlargement surrounds the joint.

Arthritis deformans in children, although not frequent, is more acute and is more influenced by poor food, cold and damp, etc. There is fever, sometimes a chill. The swelling, stiffness and tenderness seem to be more in the soft parts than in harder tissues. The fingers are flexed and overlapped, the feet are strongly extended and the joints are rigid.

The diagnosis of arthritis deformans must be made from subacute and chronic rheumatism, gonorrhœal rheumatism, gout, progressive muscular atrophy, Charcot's disease, etc. Recovery is rare, but the disease is not directly dangerous to life.

Treatment will vary according to the type of cause. Chronic infective foci as from tonsils, teeth, old suppuratur foci of the tubes, endometrium, intestines, prostate, etc., etc., should all be cleared up, not by too radical a surgery, such as divest the human being from his teeth, his intestines or other of his essential properties, but a stimulating, healthful, tonic therapy, chiefly psycho-therapeutic with the accessory aids of travel, or by hydrotherapy, or specially indicated pharmacotherapy — iron or arsenic if anæmia be present, mercury for syphilis, etc. Local treatment is usually worthless but certain forms of baking, counter-irritation to the joints and certain types of deep massage for the trophic vegetative nerve fibers are indicated. See ANTHRITIS; GOUT; RHEUMATISM. Consult Jelliffe and White, 'Diseases of the Nervous System' (Chapters on the Vegetative Nervous System and Bony Syndromes).

SMITH ELY JELLIFFE.

ARTHROCACE (Neo.-Lat. from Gk. *ἄρθρον*, joint + *κακή*, evil), a disease of the joints in which the bone is disintegrated and carried away piecemeal. See CARIES.

ARTHRODIA. See JOINT.

ARTHRODYNIA (Neo.-Lat. from Gk. *ἄρθρον*, joint + *ὀδύνη*, pain), pain in a joint; practically synonymous with arthralgia.

ARTHROGASTRA (Neo.-Lat. from Gk. *ἄρθρον*, joint + *γαστήρ*, abdomen), a division of the insect class Arachnida (q.v.), having the abdomen annulated, and including spiders and scorpions. See SCORPION.

ARTHROMERE (Gk. *ἄρθρον*, joint + *μέρος*, part), one of the series of segments of which arthropoda (q.v.) are composed.

ARTHROPATHY, a disorder of the joints either due to local inflammatory reactions as in the various acute or chronic rheumatic infections or resulting from disorder of the nervous control of the healthy metabolism of the joints as seen in tabetic arthropathy or the arthropathies of chronic lung and heart disease, multiple sclerosis, poliomyelitis, syringomyelia, etc. The health of the joint is largely dependent upon the functioning of the vegetative nervous system which controls the growth or trophiem of the joint. The cells regulating this control are located in the lateral horns of the spinal cord.

ARTHROPHRAGM (Gk. *ἄρθρον*, joint + *φράγμα*, fence), a partition between certain articulations as for example in the crayfish (q.v.).

ARTHROPLEURE (Neo.-Lat. *Arthropleura*, from Gr. *ἄρθρον*, joint + *πλευρά*, side), the lateral portions of the arthroderm, or crust, of articulated animals. See ARTICULATA.

ARTHROPODA, a phylum comprising those articulated animals which have jointed appendages such as antennæ, jaws, maxillæ (or accessory jaws), palpi and legs arranged in pairs, the two halves of the body thus being more markedly symmetrical than in the lower animals. It is by far the most numerous in species of any in the animal kingdom, the insects alone probably numbering upward of a million species; other representative or typical forms are the trilobites, king crabs, scorpions, spiders and myriopods. The skin is usually hardened by the deposition of salts (carbonate and phosphate of lime) and of a peculiar organic substance called chitine. The segments (somites or arthromeres) composing the body are usually limited in number, 20 (or 21) in the crustaceans and insects; while each arthromere is primarily divided into an upper (tergum), lower (sternum) and lateral portion (pleurum). These divisions, however, cannot be traced in the head of either the crustaceans or the insects. Moreover, the head is well marked with one or two pairs of feelers or antennæ and from two to four pairs of biting mouth-parts or jaws and two compound eyes; besides the compound eyes there are simple eyes in the insects. The germ is three-layered and there is usually in the more specialized forms a well-marked metamorphosis. The *Arthropoda* are most nearly related to the worms, certain annelides, with their soft-jointed appendages (tentacles as well as lateral cirri) and more or less definite head, anticipating or foreshadowing the arthropods. On the other hand, certain low parasitic arthropods, as linguatula, have been mistaken for geunine parasitic worms.

Segmentation of the Body.— The segments (somites metameres) are merely thickenings of the skin connected by a thin intersegmental membrane, so that the segments can telescope into each other or extend, thus lending the greatest freedom of motion to the trunk as well as to the appendages; otherwise a rigid chitinous skin would not permit of any movement. As in the annelid worms, this segmentation of the integument is correlated with the serial repetition of the ganglia of the nervous system, of the ostia of the dorsal

vessel, the primitive disposition of the segmental and reproductive organs, of the soft, muscular dissepiments which correspond to the suture between the segments and with the metameric arrangement of the muscles controlling the movements of the segments on each other; and this internal segmentation or metamerism is indicated very early in embryonic life by the mesoblastic somites.

While we look upon the dermal tube of worms as a single but flexible lever, the body of the arthropods, as Graber states, is a linear system of stiff levers. We have here a series of stiff, solid rings or hoops united by the intersegmental membrane into a whole. When the muscles extending from one ring to the next behind contract, and so on through the entire series, the rings approximate each other.

The origin of the joints or segments in the limbs of arthropods was probably due to the mechanical strains to which what were at first soft fleshy outgrowths along the sides of the body became subjected. Indeed, certain annelid worms of the family *Syllidæ* have segmented tentacles and parapodia, as in Dujardinia. We do not know enough about the habits of these worms to understand how this metamerism may have arisen, but it is possibly due to the act of pushing or repeated efforts to support the body while creeping over the bottom among broken shells, over coarse gravel or among sea-weeds. It is obvious, however, that the jointed structure of the limbs of arthropods, if we are to attempt any explanation at all, was primarily due mainly to lateral strains and impacts resulting from the primitive endeavors of the ancestral arthropods to raise and to support the body while thus raised and then to push or drag it forward by means of the soft, partially jointed lateral limbs which were armed with bristles, hooks or finally claws. By adaptation or as the result of parasitism and consequent lack of active motion the original number of segments may by disuse be diminished. Thus in adult wasps and bees the last three or four abdominal segments may be nearly lost, though the larval number is 10. During metamorphosis the body is made over and the number, shape and structure of the segments are greatly modified.

History and Present Classification.— The group or sub-kingdom (phylum) of *Arthropoda* was founded in 1848 by Siebold. It has been supposed until recently to be a natural group. In 1893 Kingsley and also Kennel first suggested doubts as to the homogeneity of the group and in the same year Packard published the view that there are four independent lines of development in the *Arthropoda*, and in 1894 Kingsley divided the group into three subphyla, Laurie and Pocock also considering that the group is polyphyletic. In 1898 Packard stated: "It is becoming evident, however, that there was no common ancestor of the *Arthropoda* as a whole, and that the group is a polyphyletic one. Hence, though a convenient group, it is a somewhat artificial one, and may eventually be dismembered into at least three or four phyla or branches."

The five phyla as afterward proposed by Packard are, beginning with the most primitive: (1) *Palæostraca*, embracing the classes of *Trilobita;* (2) *Merostomata* (*Limulus*), *and Arachnida;* (3) *Pancarida* (*Crustacea*); (4) *Prosogoneata*, including three classes: *Pauropoda, Diplopoda* and *Lymphyla* (*Scolopendrella*); and (5) *Entomoptera*, comprising the *Chilopoda* and *Insecta;* the great majority of the group being winged insects. Each of these phyla represent independent lines of development, judging by their structure and what we know of their development, and have no genetic connection beyond the theory that they each have descended from one or more annelid worms.

ARTHROSTRACA, crustacea of the subclass *Malacostraca* in which the first, sometimes the second thoracic segment is fused with the head and bears maxillipedes; the remaining seven being free and bearing legs. The eyes are usually sessile. The group is divided into the *Amphipoda* (q.v.) and *Isopoda* (q.v.) Common examples are pill-bug, wood-louse, etc.

ARTHUR, king of the Silures in the 6th century, an ancient British hero, whose story has been the theme of much romantic fiction. He is said to have been the son of Uthyr, chief commander of the Britons, and to have been born about 501. In 516 he succeeded his father in the office of general, and performed those heroic deeds against the Saxons, Scots and Picts which have made him so celebrated. He married the celebrated Guinevere belonging to the family of the dukes of Cornwall; established the famous order of the Round Table; and reigned, surrounded by a splendid court, 12 years in peace. After this he is reported to have conquered Denmark, Norway and France, slain the giants of Spain and journeyed to Rome. From thence he is said to have hastened home on account of the faithlessness of his wife, and Modred, his nephew, who carried on an adulterous intercourse, and stirred up his subjects to rebellion; to have subdued the rebels, but to have died in consequence of his wounds, in 542, on the island of Avalon, where it is pretended that his grave was found in the reign of Henry II. The story of Arthur is supposed to have some foundation in fact, and it is generally believed that he was one of the last great Celtic chiefs who led his countrymen from the west to resist the settlement of the Saxons in southern Britain. But many authorities regard him as a leader of the Cymry of Cumbria and Strath-Clyde against the Anglo-Saxon invaders of the east coast and the Picts and Scots north of the Forth and the Clyde. In our own day the interest of the old legends has been revived by the works of Lytton and especially Tennyson. For bibilography, see ARTHURIAN LEGENDS.

ARTHUR, Prince. See CONNAUGHT, DUKE OF.

ARTHUR, duke of Brittany, the grandson of King Henry II of England: b. 1187; d. 1203. On the death in 1199 of his uncle, Richard I, who had declared the boy his heir, Arthur was proclaimed King of England by the nobles of Anjou, Touraine and Maine, while the English lords decided in John's favor. King Philip of France supported the claims of Arthur, but a peace being presently concluded between John and Philip, Arthur came later into the hands of his uncle, King John, and soon mysteriously disappeared. According to general belief Arthur was murdered by command of his uncle.

The story of Arthur forms a portion of Shakespeare's 'King John.' See JOHN.

ARTHUR, Chester Alan, the 21st President of the United States: b. Fairfield, Vt., 5 Oct. 1830; d. New York, 18 Nov. 1886. He was graduated from Union College at 18, was principal of an academy at North Pownal, Vt., and in 1853 began the practice of law in New York, where he argued several important legal cases in behalf of the colored people. Through these and other cases he became noted in his profession, and he was also prominent as a Republican politician. In April 1861 Gov. E. D. Morgan made him acting quartermaster-general, and later he was made full quartermaster-general. For the next decade he was a successful and widely known practising lawyer and a leading Republican politician of New York, chairman of the Grant Club in 1868, and of the executive committee of the Republican State committee in 1869. He was appointed by President Grant, 20 Nov. 1871 to the highest office in the State patronage, the collectorship of the port of New York, which he held till 11 July 1878. His business conduct of the office was not impeached, and he was retained by President Hayes for over a year after his accession; but he was first of all a political manager, in open hostility to civil service reform. As a matter of actual practice and not theory, however, Mr. Arthur produced figures to show that the annual percentage of removals under him for all causes had been only 2¾ per cent, as against an annual average of 24 per cent since 1857. In 1880 he was nominated for the vice-presidency, chiefly to conciliate the Grant section of the Republicans, sore at the defeat of the third-term project, and was elected with Garfield. In place of the customary dignified nullity of his office, he remained an active party leader in the patronage contest of his State between the «Stalwarts» or Grant section led by Roscoe Conkling (q.v.), and of which Mr. Arthur was chief lieutenant, and the «Half-Breeds» or more independent wing which Garfield was trying to build up. Conkling soon resigned his seat in the Senate, declaring that Garfield had broken his promises to him, and the Garfield party for the time was triumphant; but the assassination of Garfield, shortly after, reversed the situation. The open lamentations of the press at the prospect of the accession of so convinced a spoilsman as himself deeply hurt Mr. Arthur, who felt that he was misjudged, and determined on the most admirable revenge, that of disappointing their prophecies of evil. He did so; not only was his term of office measurably free from the dominance of patronage, but he extended the civil service rules and kept faith with them. In other respects his administration was so excellent that the leading Independents had announced their intention of supporting him for President if nominated in 1884. Its most notable incident was the appointment of a commission to revise the tariff, which, though composed of strong Protectionists, reported that the tariff should be reduced 20 per cent all around, a recommendation unheeded by Congress. Several commercial treatics were passed, however. He vetoed a Chinese immigration bill as inconsistent with treaty obligations; favored the stringent laws passed against polygamy, appointed a Utah commission to supervise their enforcement; managed Indian affairs wisely, promoting Indian education and the breaking up of the tribal system; extended postal facilities; took measures to increase the navy, improve its discipline and efficiency and provide for coast defense; supported the improvement of Mississippi River navigation, etc. The attempts at remonetizing silver, and at forcibly abrogating the Clayton-Bulwer treaty to build a Nicaragua Canal, were in accordance with general party feeling at the time. The lingering scandal of the Star Route frauds, however, injured the party somewhat, and its policy and methods were gravely disapproved of by the Independents; but this was much more than counterbalanced by distrust of the Democratic party for its alliance with the Greenback element. Mr. Arthur's defeat for the nomination was not caused by any demerits of his own, still less by desire to conciliate the Independents, but by the personal ambitions of Republican leaders, which, justly or unjustly, had aroused and exasperated the Republicans of the State of New York, causing the defeat of C. J. Folger for Governor, and resulting in the nomination of Blaine in 1884. Arthur, although a close adherent of Conkling, supported Blaine. Consult Smalley, G. W., 'Life of C. A. Arthur' (New York 1880).

ARTHUR, SIR George, British colonial administrator: b. 1784; d. 1854. He was lieutenant-governor of the Honduras 1814–22; of Van Diemen's Land 1824–37, and the last lieutenant-governor of Upper Canada 1837–41. It fell to his duty to suppress the Upper Canada rebellion of 1837–38, and for his services he was rewarded with a baronetcy. He was governor of Bombay 1842–46, and only the state of his health prevented him from succeeding to the position of Viceroy of India.

ARTHUR, Joseph Charles, American botanist: b. Lowville, N. Y., 11 Jan. 1850. He was graduated from Iowa State College in 1872, and subsequently studied at the universities of Johns Hopkins, Harvard and Bonn, Germany. He was instructor in the universities of Minnesota and Wisconsin; botanist at the Experiment Station, Geneva, N. Y., and for 28 years professor of vegetable physiology and pathology at Purdue University, Lafayette, Ind. Since September 1915, he has been professor emeritus of botany at the last-named institution. He is the author of more than 200 articles in periodicals of a scientific nature, and some 80 of these refer to plant rusts of Uredinales. He has written (with Barnes and Coulter) 'Handbook of Plant Dissection' (1886); (with MacDougal) 'Living Plants and Their Properties' (1898).

ARTHUR, Julia, the stage name of Ida Lewis, an American actress: b. Hamilton, Ont., 3 May 1869. She made her professional début at the age of 14 as the Prince of Wales in 'Richard III,' and then, after three seasons, went to England to study music and drama. Her first New York success was in 'The Black Masque' at the Union Square Theatre. She made her London début February 1895 in Henry Irving's company at the Lyceum, playing rôles next to Miss Terry. Next year she accompanied Irving and Terry to America. In 1897

she brought out in New York 'A Lady of Quality' on an elaborate scale; the following season she appeared as Rosalind in 'As You Like It' at Wallack's Theatre. In 1899 she produced, at the Broadway Theatre, 'More Than Queen,' from the French of Emile Bergerat, taking the part of Josephine Bonaparte, which obtained a great success. She is the wife of B. P. Cheney. Consult Clapp, J. B., and Edgett, E. F., 'Players of the Present' (1899), and Strang, L. C., 'Famous Actresses of the Day in America' (1899).

ARTHUR, Timothy Shay, an American author: b. Newburgh, N. Y., 1809; d. Philadelphia, 6 March 1885. In 1852 he founded *Arthur's Home Magazine*. He was a voluminous writer of moral and domestic tales. His works are over 100 in number, and have had a large sale in England as well as in the United States. His most popular work was the famous 'Ten Nights in a Bar-Room.' Among his other publications were 'Tales for Rich and Poor,' 'Tales of Married Life' and 'Lights and Shadows.'

ARTHUR, William, Irish author and clergyman: b. 1819; d. 1901. During his early career he was for three years a missionary in India, after which he became secretary of the Wesleyan Church Missionary Society, then, in 1868, principal of the Wesleyan College in Belfast. Among his works are 'Personal Reminiscences of a Mission to the Mysore' (London 1847); 'The Tongue of Fire, or True Power of Christianity' (1856; 40th ed., 1885); 'The People's Day' (1855; 11th ed., 1856); 'Italy in Transition' (1860); 'The Pope, the Kings and the People' (1903).

ARTHURIAN ROMANCES, The. The figure of Arthur rests, in all probability, upon a historical basis, which has been completely transformed by the accretions of mythology, legend and romance. In the 'Historia Britonum' of Nennius, a compilation of very uncertain date, mention is made of a certain Arthur who was "dux bellorum" of the Britons against the Saxon invaders. His most brilliant achievement is stated to have been the British victory at Mount Badon (early in the 6th century). This testimony is substantiated by the Latin work of Gildas, an ecclesiastic of the 6th century, although Gildas does not mention Arthur by name. The memory of a conquering leader of this sort may well have been cherished by the English Celts in their later adversities, and his deeds magnified into the exaggerated exploits of a popular hero. The more primitive conception of Arthur is revealed in certain portions of the Welsh 'Mabinogion.' In the tale of 'Kilhwch and Olwen,' for example, he appears as the leader of a far ruder company than that generally associated with his name. In the course of time many features belonging to Celtic mythology became attached to him and his followers, which are occasionally plainly visible in the later romantic narratives. Sir Thomas Malory describes the strength of Gawain as waxing and waning each day, a peculiarity originally belonging to a supernatural being. Episodes in the story of Arthur's life may in all probability be traced to a similar source. The faithlessness of his wife and treachery of his nephew may perhaps be the rationalized form of an old myth. It has even been argued that Arthur was originally a Welsh deity or culture-hero, but this theory has not met with general acceptance.

The conception of Arthur as the heroic king of mediæval romance is due largely to Geoffrey of Monmouth. In his fictitious 'Historia Regum Britanniæ,' about 1136, or later, he elaborated the slight hints offered by Nennius and presented a complete and well-rounded portrait. A romantic parentage and a wonderful boyhood are given to Arthur, in which supernatural occurrences are not absent. A warrior of surpassing valor, he not only puts to rout the invading Saxons, but subdues Europe to his sway. In the midst of his last foreign campaign he learns of the infidelity of his wife Guanhumara and the treason of his nephew Modred, to whom he has entrusted the government of Britain. Hurriedly returning, he defeats Modred in a bloody combat, but himself receives a mortal wound, and is borne to Avalon to be healed. Too much importance can hardly be attached to this narrative, which forms the beginning of the great body of romantic literature which clustered about the name of Arthur, although the later romancers worked along very different lines from those laid down by Geoffrey. Much of the material in the 'Historia' is no doubt due to the author's own vivid imagination, but it is certain that he made use of the Arthurian legends in circulation in his native country near the Welsh border. In the 12th century there must have been many of these current among the Welsh people. On the Continent as well, the name and fame of Arthur appear to have been well known in early days. The Celts who crossed the Channel, mainly in the 5th and 6th centuries, and settled in Armorica, carried these legends with them, developed them in their own way, and transmitted them to their French neighbors. The question whence the early trouvères got the *matière de Bretagne* has been much discussed. It has been contended by some scholars that this was chiefly, if not wholly, derived from the Continent. Others have maintained that the transmission of the Arthurian stories by the Welsh to the Anglo-Normans was the most important factor in their later literary development. Sufficient evidence exists to prove the early circulation of this material both in Wales and Brittany, and the most reasonable view would seem to be that each locality contributed its share, but that a just apportionment of the indebtedness of the later romances is hardly possible.

The most illustrious shaper of Arthurian legend after Geoffrey was a Frenchman, Chrestien de Troyes. A native of Champagne, he wrote in the second half of the 12th century a series of long poems in octosyllabic couplets dealing with prominent knights of Arthur's court, Erec, Lancelot, Yvain and Perceval. A fifth piece, 'Cliges,' is connected with Arthur in a different way, while a romance dealing with Tristram has not been preserved. Chrestien carried still further the process which had been begun by Geoffrey. In his hands the knights become representative of the highest chivalric culture. They are not merely patterns of bravery, but men of sensitiveness and refinement, drawn with a surprising care for psychological analysis. Chrestien introduced into his stories the elaborate love-conventions of the day, which often

produces a certain artificiality. He stood pre-eminent among his contemporaries, and exerted a great influence, not only in France, but in neighboring countries as well, particularly in Germany. The 'Erec' and 'Yvain' were translated by Hartmann von Aue, and the 'Parzival' of Wolfram von Eschenbach probably owes a good deal to the 'Conte del Graal,' although the extent of this indebtedness is disputed.

Chrestien's sources are no longer extant, but it seems likely that these consisted largely of short narratives in verse. Some idea of the character of these may be gained from the Breton *lais* of the poetess Marie de France, although Marie's poems are no doubt far more artistic than the reworkings of popular story of which Chrestien made use. Many lays upon Arthurian subjects must have been in existence at this time. The work of Marie herself, although indirectly most significant in considering the literary evolution of the Arthurian legends, is but slightly connected with Arthur, only one of her lays having a setting at his court.

Meanwhile the popularity of Geoffrey of Monmouth's imaginary history was calling forth various paraphrases in England. The demand for a version in French was met by the rhymed translation of Geoffrey Gaimar, produced shortly before the middle of the 12th century. Only a part of this is extant, but a compensation for its loss appears in the poem by the Norman Wace, which seems to have been considered a more distinguished work than Gaimar's. Wace treated Geoffrey's material with considerable freedom, making additions and omissions as he thought fit. His work falls early in the third quarter of the 12th century.

The chronicle of the British monarchs was put into English about the year 1205 by Layamon, a monk of Ernley on the Severn, and called, after the reputed founder of the royal line, the *Brut*. Of this, about one-third deals with Arthur. It was based largely on the poem of Wace, but the English monk gave a very different coloring to his work than did the elegant Norman. Arthur becomes a more truly English hero, and his deeds are told in the alliterative verse of the Germanic stock, although rhyme and even assonance occasionally appear. The English character of the work is apparent in the vocabulary, which contains very few words of Romance origin. Like Geoffrey of Monmouth, Layamon drew from traditions near the Welsh border, adding to the Arthurian story material of great interest. Particularly noteworthy is the account of the Round Table, an institution borrowed from Celtic sources to settle questions of precedence in sitting at meat.

In the further development of the Arthurian romances the tendency to exalt the individual knights rather than the great king becomes more marked. Arthur is, indeed, the most majestic figure of all, but he remains in the background, while great exploits are performed by his followers. Gradually a number of cycles arise, centring about prominent figures, Gawain, Lancelot, Perceval, Yvain, Merlin. Tales originally unconnected with Arthur's court are partly localized there, and their heroes made members of the Round Table fellowship, as the Quest of the Holy Grail, which consists of the fusion of a Celtic narrative of adventure and an ecclesiastical legend, or the story of Tristram and Ysolt. A vast body of verse-romances thus came into existence, together with long compilations in prose. Chaucer did his part in telling of "tholde dayes of the king Arthour" in the Wife of Bath's tale. In the 15th century the degeneration of the minstrel romance was rapid. With the decline of the chivalric system came the decay of the romantic stories which glorified it. Prose redactions, often of inferior artistic merit, became more and more common. Meanwhile some Arthurian material reappeared in altered form in the popular ballads. A notable exception to the general level of romance-writing in this period is the 'Morte Darthur' of Sir Thomas Malory, a book which unites episodes drawn from various sources into one harmonious whole, and presents, not merely an account of Arthur's death, but of his whole life, with detailed descriptions of the adventures of the knights of his court. For charm of narrative, and cadence and melody of language, it has no rival among English romances. Written about 1470, and published 15 years later by Caxton, it may be regarded as the classic presentation of the Arthurian story for English readers.

There is little consistency in the legends grouped about the figure of Arthur. Not only were episodes altered at will, but the conceptions of the characters of prominent persons vary in different versions. As the taste of the times changed, one hero displaced another, and one set of romances drove others out of vogue. In the Grail romances, for example, the earlier heroes Gawain and Perceval were supplanted in times of greater insistence upon purity by the stainless, but less virile Galahad. Lancelot and Merlin were particularly popular in later days. Still further changes have been introduced in modern times. The 'Faërie Queene' of Spenser, which presents Arthur as the ideal type of manhood, bears little resemblance to earlier portraits of the hero. It is well known that Milton projected an epic on the story of Arthur before turning to the composition of 'Paradise Lost.' The most important effort of modern times to reproduce Arthurian legend is perhaps Tennyson's 'Idylls of the King.' These are based mainly on Malory, but the poet allowed himself much freedom both in episode and characterization. Swinburne, Matthew Arnold, William Morris and others have rendered several of the old stories into verse. In foreign countries the Arthurian material has enjoyed considerable popularity. Especially noteworthy are Wagner's music-dramas, 'Parsifal' and 'Tristan und Isolde.' See MABINOGION; AVALON; TRISTAN.

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ARTHUR'S SEAT, a hill overlooking Edinburgh, Scotland, said to have been so called from a tradition that King Arthur surveyed the country from its summit and defeated the Saxons in its neighborhood. It is a steep, and in some places precipitous, rock, exhibiting on the south side a range of perpendicular basaltic columns, called Samson's Ribs. The highest point is 822 feet above sea-level. From hence may be seen a wide expanse of sea, the course of the Forth, the distant Grampians, etc., and a large portion of the most populous and best cultivated part of Scotland, including the picturesque city of Edinburgh and its castle. On the north side are the ruins of a chapel and hermitage, dedicated to Saint Anthony, and a fine spring called Saint Anton's Well. A carriage road called the Queen's Drive goes round its base.

ARTICHOKE, two plants of the family *Asteraceæ*. The true, sometimes called French, artichoke (*Cynara scolymus*), a native of the Mediterranean region, is a coarse, stout, perennial, thistle-like herb, three to five feet tall, with rather spiny leaves, the lower of which are often three feet or more long, and large terminal heads of blue or white flowers. It is cultivated for the edible thickened outer scales and "bottoms" (receptacles) of the flower heads which sometimes exceed four inches in diameter without becoming too old for eating raw as salad, pickled or cooked like cauliflower. Sometimes the young stems and leaves are blanched and cooked as a pot-herb. In Europe many varieties are popular; in America the globe variety is planted almost to the exclusion of others, with the result that this variety has almost become united to the name in popular usage. The cultivation of this species in America is confined mostly to the southern States and California. Since the plant is rather tender, winter protection must be given where the ground freezes. If planted in rich soil and set four feet apart the plants will yield two or three crops before a new plantation should be made; if allowed to stand longer the yield gradually diminishes. New plantations are made either with seedling or sucker plants. Most of the artichokes offered in the Northern markets of the United States come from California.

The Jerusalem artichoke (*Helianthus tuberosus*), a native of eastern North America, is a perennial sunflower-like herb, five to 12 feet tall, with rough leaves four to eight inches long and many yellow terminal flower-heads often two to three inches in diameter. The edible pear-shaped purplish, red, white or yellow tubers for which the plant is often cultivated are numerous, seldom more than three inches in diameter, rather watery but of pleasant flavor, especially when prepared like cauliflower, with a white sauce. Perhaps no vegetable is of easier cultivation. For home use the tubers are generally planted in well-drained soil in some out of the way corner of the garden and allowed to take care of themselves from year to year, the few tubers and pieces of root left after digging sufficing to restock the bed. In field culture the methods are like those practised with the potato except that the tubers may be left in the ground over winter and dug when needed. They are not injured by frost if in the soil, but if frozen after being dug they spoil quickly. If desired they may be dug and stored in pits like turnips, but with a somewhat lighter covering of straw and earth. The usual yield is from 200 to 500 bushels to the acre. When land becomes infested, as it sometimes does, with the plant, pigs, for which the tubers make valuable food, may be turned loose upon the field. The tubers resemble potatoes in composition and like them are used largely in Europe for the manufacture of alcohol. The young plants are sometimes used as cattle food and the dry stalks for fuel. Consult 'Bur or Globe Artichoke' (in United States Department of Agriculture Year Book, 1899); Circular 31 (1899); Bailey, 'Standard Cyclopedia of Horticulture' (1914); Vilmorin, 'The Vegetable Garden' (translation by Robinson, 1885).

ARTICLE, in grammar, a part of speech used before nouns to limit or define their application. In the English language *a* or *an* is the indefinite article (the latter form being used before a vowel sound) and *the* the definite article. The English indefinite article is really a modified form of the numeral adjective *one;* so the German *ein* and the French *un* stand for the numeral and the article. There are traces in various languages showing that the definite article was originally a pronoun; thus the English *the* is closely akin to both *this* and *that.* The Latin language has neither the definite nor the indefinite article; the Greek has the definite; the Hebrew and Arabic definite article was prefixed to its noun, while, on the other hand, in the Syriac and Chaldaic it was affixed to the noun, as it is in the Icelandic. In the Scandinavian language the definite article is appended to the end of the word as *hus-et,* the house. There is no article in Russian.

Articles, divisions of a printed or written document or agreement. A specification of distinct matters agreed upon or established by authority or requiring judicial action. In chancery practice articles are a formal written statement of objections to the credibility of witnesses in a cause in chancery, filed by a party to the proceedings, after the depositions have been taken and published. The object of articles is to enable the party filing them to introduce evidence to discredit the witnesses to whom the objections apply, where it is too late to do so in any other manner (2 Daniel Chan. Pr. 1158), and to notify the party whose witnesses are objected to of the nature of the objections, that he may be prepared to meet them. Upon filing the articles a special order is obtained to

take evidence. The interrogatories must be so shaped as not to call for evidence which applies directly to facts in issue in the case. 3 Johns. Ch. N. Y. 558. The objections can be taken only to the credit and not to the competency of the witnesses. 3 Johns. Ch. N. Y. 558; 3 Atk. Ch. 643, and the court are to hear all the evidence read and judge of its value. 2 Ves. Ch. 219.

Articles of Association.— *In law,* written regulations agreed upon by the parties to a joint enterprise.

Articles of Agreement.— A written memorandum of the terms of an agreement. They may relate either to real or personal estate, or both, and if in proper form will create an equitable estate or trust such that a specific performance may be had in equity. The articles of agreement should contain a clear and explicit statement of the names of the parties, with their additions for purposes of distinction, as well as a designation as parties of the first, second, etc., part; the subject-matter of the contract, including the time, place, and more important details of the manner of performance; the covenants to be performed by each party; the date, which should be truly stated. It should be signed by the parties or their agents. When signed by an agent the proper form is A. B., by his agent (or attorney), C. D.

Articles of Confederation.— The title of the compact which was made by the 13 original States of the United States of America. It was adopted and carried into force 1 March 1781 and remained as the supreme law until the first Wednesday of March 1789.

Articles of Faith.— Summarized statements of religious views relating to the central doctrines of a theological system. Protestant divines divide these into fundamental and nonfundamental articles. Familiar examples of articles of faith are the Nicene, Apostles' and Athanaisan creeds, the Thirty-Nine Articles, the Westminster, Augsburg and Helvetic Confessions. See CREED AND CONFESSIONS.

Articles of Impeachment.— A written articulate allegation of the causes for impeachment. Blackstone calls them a kind of bill of indictment, and they perform the same office which an indictment does in a common criminal case. They do not usually pursue the strict form and accuracy of an indictment, but are sometimes quite general in the form of their allegations. They should, however, contain so much certainty as to enable a party to put himself on the proper defense, and in case of an acquittal to avail himself of it as a bar to another impeachment. Additional articles may perhaps be exhibited at any stage of the proceedings. The answer to articles of impeachment is exempted from observing great strictness of form, and it may contain arguments as well as facts. A full and particular answer to each article of the accusation should be given.

Articles of Partnership.— A written agreement by which the parties enter into a partnership upon the conditions therein mentioned. The instrument should contain the names of the contracting parties severally set out; the agreement that the parties do by the instrument enter into a partnership, expressed in such terms as to distinguish from a covenant to enter into a partnership at a subsequent time; the date and necessary stipulations, some of the more common of which follow. The commencement of the partnership should be expressly provided for. The date of the articles is the time, when no other time is fixed by them. The duration of the partnership should be expressly stated. It may be for life, for a limited period of time, or for a limited number of adventures. When a term is fixed it is presumed to endure until that period has elapsed, and when no term is fixed, for the life of the parties, unless sooner dissolved by the acts of one of them, by mutual consent, or operation of law. The duration will not be presumed to be beyond the life of all the partners, but provision may be made in the articles for the succession of the executors or administrators or child or children of a deceased partner to his place and rights. Where provision is made for a succession by appointment and the partner dies without appointing, his executor or administrators may continue the partnership or not at their option. A continuance of the partnership beyond the period fixed for its termination, in the absence of circumstances showing intent, will be implied to be upon the basis of the old articles (15 Ves. Ch. 218), but for an indefinite time. The nature of the business and the place of carrying it on should be carefully stated. An injunction will be granted by a court of equity when one or more of the partners endeavors, against the wishes of one or more of them, to extend such business beyond the provision contained in the articles. The name of the firm should be ascertained. The members of the partnership are required to use the name thus agreed upon, and a departure from it will make them individually liable to third persons or to their partners in individual cases. The management of the business, or of some particular branch of it, is frequently entrusted by stipulation to one partner, and such partner will be protected in his rights by equity, or it may be to a majority of the partners, and should be where they are numerous. The manner of furnishing capital and stock should be provided for. When a partner agrees to furnish his proportion of the stock at stated periods, or pay by installments, he will, where there are no stipulations to the contrary, be considered a debtor to the firm. Sometimes a provision is inserted that real estate and fixtures belonging to the firm shall be considered as between the partners, not as partnership, but as individual property. In cases of bankruptcy, this property will be treated as the separate property of the partners. The apportionment of profits and losses should be provided for. The law distributes these equally, in the absence of controlling circumstances, without regard to the capital furnished by each. Periodical accounts of the property of the partnership may be stipulated for. These, when settled, are at least *prima facie* evidence of the facts they contain. The expulsion of a partner for gross misconduct, bankruptcy, or other specified causes may be provided for, and the provision will govern when the case occurs. A settlement of the affairs of the partnership should always be provided for. It is generally accomplished in one of the three following ways: *First,* by turning all of the assets into cash, and after paying all the liabilities of the partnership, dividing such money in proportion to the several interests of the parties; or, *sec-*

ond, by providing that one or more of the partners shall be entitled to purchase the shares of the others at a valuation; or, *third*, that all the property of the partnership shall be appraised, and that after paying the partnership debts it shall be divided in the proper proportions. The first of these modes is adopted by courts of equity in the absence of express stipulations. Submission of disputes to arbitration is frequently provided for, but such a clause is nugatory, as no action will lie for a breach.

ARTICLES OF WAR. Until the civil war in England in the reign of Charles I, it is probable that no regular permanent code of rules or articles for enforcing military discipline was in existence; the ruling authority had promulgated its orders for the government and regulation of the army as occasion required. Each war, each expedition, had its own edict, which fell into disuse again upon the disbanding of the army, which inevitably followed the cessation of hostilities. The experience of ages and the precedents of former wars, therefore, enabled the authorities to frame a sufficiently comprehensive code in case of need; accordingly, soon after the outbreak of the civil war, the necessities of the case compelled the Parliament to enact ordinances or articles of war. The first complete "Laws and Ordinances of Warre" were issued by Essex, the commander-in-chief of the Parliamentary Army in 1642. These articles are remarkable and interesting, as undoubtedly forming the groundwork of those now in use. Two years after the publication of Essex's ordinances, on the marching of the Scottish army into England, soon after the ratification of the solemn league and covenant, "articles of war" were issued for its government. These articles, although very dissimilar to those of Essex, considering that both were in force in the same kingdom at the same time, and were applicable to armies fighting on the same side, nevertheless treat mainly of the same offenses. The form of judicature established consisted of two courts of justice, called "councils of war," the one superior and the other inferior. The superior court, also called the "court of war," took cognizance of the more serious offenses, and likewise heard appeals from the decisions of the lower court, called the "martial court." No trace of the constitution of these courts is now to be found except that "the judges were sworn to do justice." Within a few months of the promulgation of the latter (August 1644), the same Parliament that was the author of the petition of right passed an ordinance establishing a system of martial law, applicable not only to soldiers, but to all persons alike. By this ordinance the Earl of Essex, captain-general of the parliamentary forces, together with 56 others named therein (among them were peers, members of the House of Commons, gentry and officers of the army), were constituted "commissioners," and any 12 of them authorized to hear and determine all such causes as "belonged to military cognizance," according to the articles mentioned in the ordinance, and to proceed to the trial, condemnation and execution of all offenders against the said articles, and to inflict upon them such punishment, either by death or otherwise, *corporally*, as the said commissioners, or the major part of them then present, should judge to appertain to justice, according to the measure of the offense. Under cover of this ordinance, which, after one refusal by the peers, was subsequently renewed, Parliament proceeded to issue a variety of orders for the conduct of the war and the regulation of the army; and many persons were tried by court-martial and executed. After the expiration of this last ordinance, the absolute executive power, in all matters of military law, fell into the hands of Cromwell, who claimed it as his right, in virtue of his office of general-in-chief. "The general," says Whitlocke, "sent his order to several garrisons to hold courts-martial for the punishment of soldiers offending against the articles of war; provided that if any be sentenced to lose life or limb, then they transmit to the judge-advocate the examinations and proceedings of the court-martial, that the *general's* pleasure may be known thereon." On one occasion, deeming it necessary, for the sake of discipline, to make an immediate example, Cromwell seized several officers with his own hand, called a court-martial on the field, condemned them to death, and shot one forthwith at the head of his regiment. It will thus be seen that the administration of martial law was almost invariably in the hands of the most considerable power in the state — it alternated between King and Parliament, and between Parliament and Dictator, as each became uppermost in the realm. On the restoration of Charles II, the army, with the exception of about 5,000 men, consisting of General Monk's regiment, called "the Coldstream," the first regiment of foot, the royal regiment of Horse-Guards, called the "Oxford Blues," and a few other regiments, was disbanded. The force kept on foot was the first permanent military force, or "Standing Army," known in England; and from it the present army dates its origin.

A statute passed in the reign of Charles II, entitled "An Act for ordering the forces in the several counties of this kingdom," recites that "within all his Majesty's realms and dominions, the sole and supreme power, government, command, and disposition of the militia, and of all forces by sea and land, and of all forts and places of strength is, and by the laws of England ever was, the undoubted right of his Majesty, and his royal predecessors, kings and queens of England." With the exception of some slight encroachment on the part of the Crown, and protests on the part of the Parliament, matters remained in very much the same state till the Revolution, at which period military law assumed a permanent and definite form as it now exists. The only allusions to the military power of the Crown, in the Bill of Rights, are "that the raising and keeping of a standing army in time of peace *without consent of Parliament*, is contrary to law"; and that "subjects, if Protestants, may have arms for their defense, suitable to their condition, and as allowed by law." In the first year, however, of the reign of William and Mary, British regiments, jealous of the supposed preference shown by William for his Dutch troops, mutinied at Ipswich. The King suppressed the mutiny with a strong hand, at the same time communicating the event to Parliament. Parliament, anxious to devise means for the con-

venient application of a code of laws for the regulation and management of the army, and at the same time determined to place a check upon the exercise of the military power of the King, passed, on 3 April 1689, for a period of six months only, the first Mutiny Act, the preamble of which is as follows: "Whereas, the raising or keeping a standing army within this kingdome, in time of peace, unlesse it be with the consent of Parlyament, is against law; and whereas it is judged necessary by their majestyes and this present Parlyament that, during this time of war, severall of the forces which are now on foote should be continued and others raised, for the safety of the kingdome, for the common defence of the Protestant religion, and for the reducing of Ireland. And whereas no man can be prejudged of life or limb, or subjected to any kinde of punishment by martiall law, or in any other manner than by the judgment of his peeres, and according to the knowne and established lawes of this realme; yet, nevertheless, it being requisite for retaining such forces as are or shall be raised during this exisgence of affaires in their duty, that an exact discipline be observed; and that soldiers who shall mutiny or stirr up sedition, or who shall desert their majestyes' service, be brought to more exemploary and speedy punishment than the usual formes of law will allow." The act provides for the assembling and constitution of courts-martial, for the oath of members, for the punishment of desertion, mutiny, sedition, false musters, etc.; for the regulation of billets; and is ordered to be read at the head of every regiment, troops, or company, at every muster, "that noe soldier may pretend ignorance." No power is, however, reserved to the sovereign to make articles of war. This act was renewed soon after its expiration; and with the exception of about three years only, viz., from 10 April 1698, to 20 Feb. 1701, has been annually re-enacted (with many alterations and amendments).

Under the Constitution of the United States, Congress only can make rules of government and regulation for the land forces, and those rules, commonly called articles of war, were originally borrowed jointly from the English Mutiny Act annually passed by Parliament, and their articles of war established by the King. The existing articles for the government of the army of the United States, enacted 10 April 1806, are substantially the same as those originally borrowed 30 July 1775, and enlarged by the old Congress from the same sources 20 Sept. 1776. The act consists of but three sections. The first declares: "The following shall be the rules and articles by which *the armies* of the United States shall be governed"; and gives 101 articles. Each article is confined, in express terms, to the persons composing the army. The second section contains the only exception in the cases as follows: "In time of war, all persons *not* citizens of, or owing allegiance to the United States of America who shall be found lurking, as *spies*, in or about the fortifications or encampments of the armies of the United States, or any of them, shall suffer death, according to the *law and usage of nations*, by sentence of a general court-martial." The third section merely repeals the previous act for governing the army. The articles of war, therefore, are, and under the Constitution of the United States can be, nothing more than a code for the government and regulation of the army. Or, in other words, within the United States these articles are "a system of rules superadded to the common law for regulating the citizen in his character of a soldier," and applicable to no other citizens. Beyond the United States, another code is essential; for although armies take with them the rules and articles of war, and the custom of war in like cases, in a foreign country, the soldier must be tried by some tribunal for offenses which at home would be punishable by the ordinary courts of law. It is impossible to subject him to any foreign dominion, and hence in the absence of rules made by Congress for the government of the army under such circumstances, the will of the commander of the troops, *ex necessitate rei*, takes the place of law, and the declaration of his will is called martial law. The most casual reader of the articles of war will be struck by the fact that whereas the Mutiny Act of Great Britain is annually subjected to the supervision of Parliament, and altered or modified according to circumstances, yet the rules and articles of war passed in 1806 have remained upon our statute-book from that day to the present without any general revision. Another fact equally important is that while the King of Great Britain not only *commands* but *governs* the British army, and therefore modifies the government of the army at his pleasure, the President of the United States is simply the commander of our army, under such rules for raising, supporting, governing and regulating it as Congress may appoint.

The articles of war, as revised in 1916, modernize the proceedings of courts-martial. There are no radical changes, and the most important are those which harmonize the proceedings of the military courts with those of modern civil courts. The reviewing authority of the proceeding of the court-martial includes: (a) The power to approve or disapprove a finding and to approve only so much of a finding of guilty of a particular offense as involves a finding of guilty of a lesser included offense when in the opinon of the authority having power to approve the evidence of record requires a finding of only the lesser degree of guilt; and (b) the power to approve or disapprove the whole or any part of the sentence.

Under the new articles it is no longer mandatory for a court to sentence an offender to dismissal for drunkenness while on duty in time of peace. The court can use its discretion. For the first time military authorities are permitted to adjudicate the affairs of deceased officers and soldiers and to hold inquests. Rights to remove civil suits or criminal prosecution against military persons from State to Federal courts are conferred upon military authorities. These cases include acts done in the line of duty. Depositions are authorized in many cases which were not provided for under the old articles of war.

ARTICLES, The Six. In English Church history these were articles of faith imposed by the Act 31 Henry VIII, cap. xiv, passed by Parliament in 1539, and known as the Six-stringed Whip or Bloody Statute, from the merciless persecutions to which it gave rise. They are supposed to have been the composition

of King Henry himself, and they had no formal authority from the Church. They enforced belief in transubstantiation; declared communion in both kinds unnecessary; the marriage of priests was unlawful; that vows of chastity or widowhood were absolutely binding; and that private masses and auricular confession were expedient and necessary. The severity of the act was soon mitigated, and it was finally repealed in the first year of Edward VI.

ARTICLES, The Thirty-nine, of the Church of England, a term applied to a body of divinity, chiefly founded on the formulary of Forty-Two Articles compiled by Archbishop Cranmer in 1551, in obedience to the command of Edward VI and the privy council, who instructed him to "frame a book of articles of religion, for the preserving and maintaining peace and unity of doctrine in this Church, that, being finished, they might be set forth by public authority." Several of these articles (the 1st, 2d, 25th and 31st) were drawn directly from the Augsburg Confession, and the 9th and 16th are traceable to the same source. During the reign of Mary the Articles were suppressed, but the accession of Elizabeth offered an opportunity of drawing up a fresh formulary. In 1562–63 a convocation was held, in the course of whose sitting King Edward's Articles were carefully considered and revised. As the result of this revision (mainly the work of Archbishop Parker, assisted by Bishops Grindal, Horn and Fox) four of the original 42 articles were omitted, namely, the 10th, 16th, 19th and 41st, and articles 5th, 12th, 29th and 30th were newly introduced; 17 other articles were more or less modified. On a further revision articles 39th, 40th and 42d were struck out, and some slight changes made in several others. These 39 articles were drawn up and ratified in Latin, but when printed both in Latin and English the 29th was omitted and the first clause of the 20th struck out. The 39th was, however, restored on a final revision by Parker in 1571, and then imposed on the clergy for subscription. They were ratified anew in 1604 and 1628. All candidates for ordination must subscribe these articles, but subscription is no longer necessary on matriculating or taking a degree at Oxford or Cambridge. This formulary is now accepted by the Episcopalian Churches of Scotland, Ireland and America.

The first five articles contain a profession of faith in the Trinity, the incarnation of Jesus Christ, his descent to hell, and his resurrection, and the divinity of the Holy Ghost. The three following relate to the canon of the Scripture. The 8th article declares a belief in the Apostles', Nicene and Athanasian creeds. The 9th and following articles contain the doctrine of original sin, of justification by faith alone, of predestination, etc. The 19th, 20th and 21st declare the Church to be the assembly of the faithful, and that it can decide nothing except by the Scriptures. The 22d rejects the doctrine of purgatory, indulgences, the adoration of images and the invocation of saints. The 23d decides that only those lawfully called shall preach or administer the sacraments. The 24th requires the liturgy to be in English. The 25th and 26th declare the sacraments effectual signs of grace (though administered by evil men), by which God excites and confirms our faith. They are two: Baptism and the Lord's Supper. Baptism, according to the 27th article, is a sign of regeneration, the seal of our adoption, by which faith is confirmed and grace increased. In the Lord's Supper, according to article 28th, the bread is the communion of the body of Christ, the wine the communion of his blood, but only through faith (article 29); and the communion must be administered in both kinds (article 30). The 28th article condemns the doctrine of transubstantiation, and the elevation and adoration of the Host; the 31st rejects the sacrifice of the mass as blasphemous; the 32d permits the marriage of the clergy; the 33d maintains the efficacy of excommunication. The remaining articles relate to the supremacy of the king, the condemnation of Anabaptists, etc.

ARTICULATA, a name given by Cuvier to a branch of the animal kingdom embracing the worms (*Annulata*) and *Arthropoda* (q.v.). The group is not now considered a natural one, and has been subdivided into several branches or phyla.

ARTICULATION. See JOINT.

ARTIFICIAL CAMPHOR, a product manufactured from turpentine. The sap of the pine tree after it is distilled and purified is the turpentine of commerce. A couple of thousand pounds of this material is placed in great steam reaction tanks; these are covered with asbestos to retain the heat. A quantity of oxalic acid, which is rich in oxygen, is likewise placed in the reaction tanks, together with the turpentine, and when the chemical action resulting from the union has been completed two new chemicals are formed and are known as pinol oxalate and pinol formate, respectively. These are in liquid form and are conveyed to a set of distilling tanks by means of a force pump; in these tanks a new element is introduced in the form of an alkali, and when mixed with the liquid live steam is turned on. After distillation camphor results, together with some of the essential oils, such as oil of lemon and others, but these are dissolved in the reaction products, which also contain a kind of camphor termed borneol.

ARTIFICIAL FLOWERS, flowers made of a large variety of materials in close imitation of natural flowers for purposes of ornament and instruction. The famous collection of Harvard University, made wholly of glass and illustrating the flora of the United States is the best example of the latter. The art was known to the ancients, for the ancient Egyptians made flowers of painted linen and stained horn shavings; gold was also used. Rice paper is used by the Chinese and Japanese and to some extent also in the United States. The South American Indians have fashioned beautiful flowers from varicolored feathers. Crape paper, ribbon and velvet are extensively used. The chief centres for the manufacture of flowers are France and the United States. Wax-flower making is a special branch of the art. The industry first developed in the United States during the decade 1830–40; there are now about 250 establishments in the United States engaged in the manufacture of artificial flowers, and employing 5,000 wage earners, and having an annual output of a value aggregating $9,041,447. In addition to the materials already named silks, cambric, calico, muslin and satin

are used in this industry. The leaves and petals are generally made of silk or cambric punched out to proper shapes and sizes. These are tinted with a brush and color, and if necessary glazed with gum or sprinkled with fine flock to imitate the glossy or velvety surface of natural flowers. The ribs, where present, are indented with a warm iron. The stamens and pistils are formed of wire covered with silk and dipped in gum-water to form the anthers. The stalk is then made of wire, coated with green paper and fixed to the stamens and pistil, around which are attached the petals, and lastly the calyx. Buds are made of cotton or glass balls covered with cambric of a proper color. The coloring matter, however, used for these articles is often nothing less than the deadly poison arsenic. Hoffman and other chemists have shown that the most terrible effects may spring from the use of these arsenical compounds. Consult Van Kleeck, M., 'Artificial Flower Makers' (New York 1913).

ARTIFICIAL LIMBS, substitutes for human arms and legs and parts thereof, toes, feet, hands and fingers, appliances for excisions, fractures and other disabilities of lower and upper extremities, the manufacture of which has received the attention of surgeons and mechanics from a very early date. In the great work on surgery by Ambrose Paré, in 1579, he refers to and gives detailed illustrations of an artificial arm and leg, and although the construction was of a rude character they showed a very good attempt to conceal the mutilation. In 1696 an artificial leg was invented by Verduin, a Dutch surgeon. It was composed of a wooden foot, to which was fastened two strips of steel extending up to the knee. To these strips was riveted a copper socket to receive the stump; a leather for lacing around the thigh was connected to the socket by two steel side-joints, thus dividing the points of support between the thigh and stump. The construction of this leg was improved later by Professor Serre of Montpelier. Improvements and new limbs were more recently introduced into England and France by Fred. Martin, M. Charrière, MM. Mathieu and Bechard, but these were mostly unprotected by patents. Thomas Mann secured patents for artificial limbs 20 Jan. 1790, and 1810. James Potts of England patented a new leg 15 Nov. 1800. This soon became celebrated as the "Anglesea leg," because it was so long worn by the Marquis of Anglesea. An improvement on this leg was patented by William Selpho, who was the first manufacturer of note in New York, where he established himself in 1839. Other inventors and manufacturers soon took a great interest in the business — so many, in fact, that the American patent office shows a record of about 150 patents on artificial legs, or more than double that of all European patents on limbs. The Civil War, which caused the mutilation of so many soldiers and sailors, and the liberality of the government in supplying their losses with artificial limbs, naturally stimulated the efforts of inventors in producing such substitutes as would be accepted. These soldiers and sailors were supplied once in every five years, and to this demand is added that of those who have lost limbs from disease or accident, making in all about 100,000 in the United States who have to be supplied with new limbs on an average of about once in every five to eight years. The perfection to which limbs have been brought is wonderful and very interesting. A person with two artificial legs can walk so perfectly as to avoid detection, and a person with a single amputation can almost defy detection. Notable improvements in artificial limbs, and more particularly in legs, were made by C. A. Frees, by J. Condell and by A. A. Marks of New York. One of these improvements, and one of the most important, consists in the movements of the knee and ankle joints, by which the whole limb is strengthened and made more durable. An important feature of this piece of mechanism consists in the introduction of a universal motion at the ankle-joint, imitating the astragalus movement with an additional joint, and thus producing a most perfect artificial substitute. Another of his improvements, of equal importance, is in the knee-joint of the leg for thigh amputation, which is so arranged that when in a sitting position the cord and spring are entirely relaxed, relieving all strain and pressure; and when rising to an upright position the cord and spring are again brought into proper position without strain or unnatural movement, no extra attachments being required. Artificial arms and extension apparatus for short legs are also wonderful examples of American ingenuity.

The great European War gave a great impetus to the manufacture of artificial limbs, and organized effort was made especially by the French authorities to place the entire technique of artificial limb supply upon a standardized scientific basis. A laboratory of military prosthesis was established in Paris where careful determinations were made of the muscular and nervous conditions in and around the damaged limb. In accordance with these observations, individual prescriptions were made and carried out with a degree of skill which could not by any possibility be approached in times of peace, with the negligible number of cases which then arise. A German firm perfected a system attached rigidly to the shoulder, whereby movements based upon the humerus, collar-bone or shoulder-blade are transmitted to the stump of the forearm. The hook terminating this artificial arm can be subjected to heavy loads without in the least straining the enfeebled muscles of the wounded man.

An artificial arm for those whose amputation had preserved the elbow-joint was constructed by an American firm which made possible a large variety of movements. Flexions of the wrist, opening and rotating of the "hand," placing the "fingers" in certain positions and holding them firmly there, are all accomplished with no intervention of the other hand aside from the engaging and disengaging of a catch.

The average price for an arm fitted to an amputation above elbow, with full finger and universal wrist movement is from $100 to $125 and $150; below the elbow from $75 to $100; for a leg above or below the knee the prices are about similar. Consult Condell, J., 'Life-like Artificial Legs and Arms' (New York 1886); Marks, A. A., 'Manual of Artificial Limbs' (New York 1914); Palmer, B. F., 'Will the American Government Present an Artificial Arm (Not a "Clutch") to the Mutilated American Soldier?' (Philadelphia 1863).

ARTIFICIAL PRECIOUS STONES. See CHEMISTRY, PROGRESS OF; GEMS.

ARTIFICIAL RESPIRATION. See ASPHYXIA; DROWNING (*Treatment*); RESPIRATION.

ARTIFICIAL RUBBER. See RUBBER.

ARTIFICIAL STONE, a combination of hydraulic cement, broken stone, sand, etc., cemented together. There are many varieties, some of which are exceedingly valuable for building purposes, especially in localities where building-stone is not readily obtained. Cements thus made increase in strength and solidity for an indefinite period. This stone is in constantly increasing demand. For the various kinds and uses see CEMENT.

ARTIGAS, är-tē'gas, **Fernando José,** a South American soldier, dictator of Uruguay: b. Montevideo, 1755; d. 1851. At an early age he was appointed captain of a corps in the Spanish provincial service. In 1811 he joined the revolt of Buenos Aires against Spain, whose troops he repeatedly defeated; but acting for himself was outlawed by the insurrectionary junta, whose troops in turn he routed and compelled it to cede Uruguay to him in 1814. He then assumed the dictatorship, but in 1820 was defeated and fled to Paraguay, where the dictator Francia banished him to Candelaria. Thereafter he devoted himself to agriculture and philanthropy.

ARTIGAS, Uruguay, a department of the republic, established by the law of 20 Sept. 1884, which occupies the northern extremity of the country. Its capital, San Eugenio del Careim (also called Cuareim) is situated on the Cuareim River, which separates Uruguay from Brazil. The department is bounded on the north and northeast by Brazil, on the southeast by the department of Rivera, on the south by the department of Salto and on the west by the Uruguay River and Argentina. It is the eighth in size of the 19 Uruguayan departments; is crossed by two railway lines; is divided into the eight judicial sections known as San Eugenio, Cuasó Grande, Catalán Chico, Yacuaré, Yucutujá, Estación Isla Sarandi, Santa Rosa and Estación Cabello, and has about 33,000 inhabitants (est. 1916). The name Artigas is also given in honor of Fernando José Artigas (q.v.) to a town of 1,300 inhabitants in the department of Cerro Largo, Uruguay.

ARTILLERY. Projectile arms using gas as a propelling force, and also the troops serving these arms. The history of artillery dates from the discovery of gunpowder in the 13th century. Several small guns were in action at the battle of Crecy in 1346. In the French War of Independence against the English, artillery was in constant use, and in 1428 Joan of Arc is said to have pointed the guns herself. During the 16th century brass guns and cast-iron projectiles were adopted throughout Europe, while Tartaglia in Italy made great improvements in gunnery. During the latter part of this century case-shot was invented and shells were fired from mortars. The first half of the 17th century forms an era in the history of artillery. Maurice and Henry Frederick of Nassau made much advancement in it, but it was under Gustavus Adolphus that it first began to take its true position on the battlefield. He attached two guns to each regiment, and proved its utility in the Thirty Years' War. During his life he did much to forward the science of artillery, increasing its mobility and its rapidity of fire. The laboratory at Woolwich was established in 1672, and a reorganization of artillery took place in 1682 under Lord Dartmouth. Louis XIV raised in 1671 a regiment for artillery duty, and in 1690 founded the first artillery schools. The inventions of the elevating-screw, the prolonge and the priming-tube filled with powder, were made during his reign.

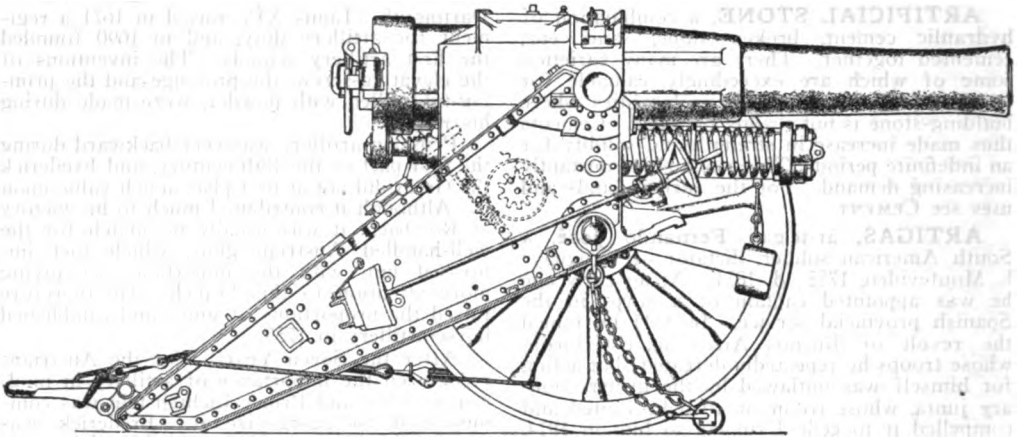
Prussian artillery was very backward during the first part of the 18th century, and Frederick the Great did not at first place much value upon it. Although it contributed much to his victory at Rossbach, it was usually no match for the well-handled Austrian guns, which fact impressed him with the importance of giving more attention to this branch. He therefore raised the proportions of guns, and established horse-artillery in 1759.

After the Seven Years' War the Austrians recognized the importance of artillery in modern warfare, and Prince Lichtenstein was commissioned to reorganize it. Frederick was struck with the improvements effected in Austria, and strove on his return to build up a complete system, as to both personnel and matériel, making a separate provision for field, siege, garrison and coast artillery. At first his reforms met great opposition, but in 1776 he became First Inspector-General of Artillery, and was able to carry through his improvements. French horse-artillery dates from 1791, and the last step in the complete organization of field-artillery was made in 1800, when the establishment of a Drivers' Corps put an end to the old system of horsing by contract. Napoleon introduced the tactical combination with brilliant success. To his wars we first look for instances of the important effects produced by this arm in that concentration of fire which in those days was produced only by massing guns. After the war of 1870–71, in which French artillery proved itself far inferior to the German, the French made remarkably successful experiments with a view to the introduction of superior guns. Similar progress has been made by the other great European Powers.

British artillery had greatly deteriorated during the 18th century, and was not up to the standard of other countries, but horse-artillery was formed in 1793, and a Drivers' Corps introduced the following year. At the commencement of the 19th century Prussian artillery was powerful rather than mobile; but after the disasters of 1806–07, this defect was remedied. In 1872 German artillery was reorganized, the field-artillery of each army corps being augmented to 17 batteries and divided into two regiments. Austrian artillery has always been pre-eminent both in the excellence of its matériel and in tactical handling on the field. Russia won special distinction in the Napoleonic wars by the power and good service of its artillery, and has continued to give great attention to this arm. Having adopted the breech-loading system of Prussia, Russia increased its field-artillery from three to four batteries per division, with 38 batteries of mitrailleuses added.

The defense of warships with iron armor caused an increase in the size, weight and calibres of sea-coast and naval cannon, and the whole method of gun-construction was altered. Armstrong was the first in England to see the necessity of a change, and his method was improved by Whitworth, Fraser, Palliser, Blakely and others. Francis Krupp of Essen, Prussia, invented a new method which proved so successful that it was introduced in Germany, Russia, Austria, Belgium and Spain. The body of the gun was fabricated from a solid ingot of low steel worked under heavy steel hammers and was strengthened by three or more steel tubes shrunk upon the central tube of the gun, the last ring, or tube, inclosing the breech, being forged in one piece with the trunnions, without a weld. The rings had various lengths and the gun was diminished in thickness toward the muzzle, not by tapering, but by being turned with concentric steps of diminished heights. Krupp made all his projectiles and gun-carriages of steel. In the United States, Rodman, Dahlgren and Parrott devoted themselves to the art of gun-construction. The Rodman gun was of cast-iron; it was cast hollow and cooled from the inside, the exterior being in the meantime kept from rapid cooling by fires built around the gun in the casting pit. The Dahlgren gun was of iron cast solid and cooled from the exterior, very thick at the breech up to the trunnions, then diminishing in thickness to the muzzle. The Parrott gun, like the Rodman, was of cast-iron, cast hollow, cooled from the inside and strengthened about the chamber by an exterior tube of wrought-iron bars spirally coiled and shrunk on.

During the past 25 years the struggle between gun and armor has gone continuously forward. An examination of the products of the Midvale Steel Company, Bethlehem Steel Company and foreign ordnance corporations shows ever-increasing gun power, culminating in the English made, Italian-owned gun, having a bore whose diameter is 17 inches. The actual weight of this gun is 104 tons and its projectile turns the scale at 2,000 pounds. The execution of this gun will be realized when it is remembered that the six-inch gun is capable of crashing a 100-pound projectile through fully a foot of wrought-iron. This monster, ponderous as it is, is surpassed in two important respects by the 16.25-inch breech-loading gun. This celebrated weapon throws a projectile weighing two cwt. less than the 17-inch, but has a more powerful muzzle velocity and a penetrating power superior by a couple of inches. With an initial velocity of 23 miles per minute it is not surprising that this gun can send a projectile through three feet of solid wrought-iron like so much cardboard.

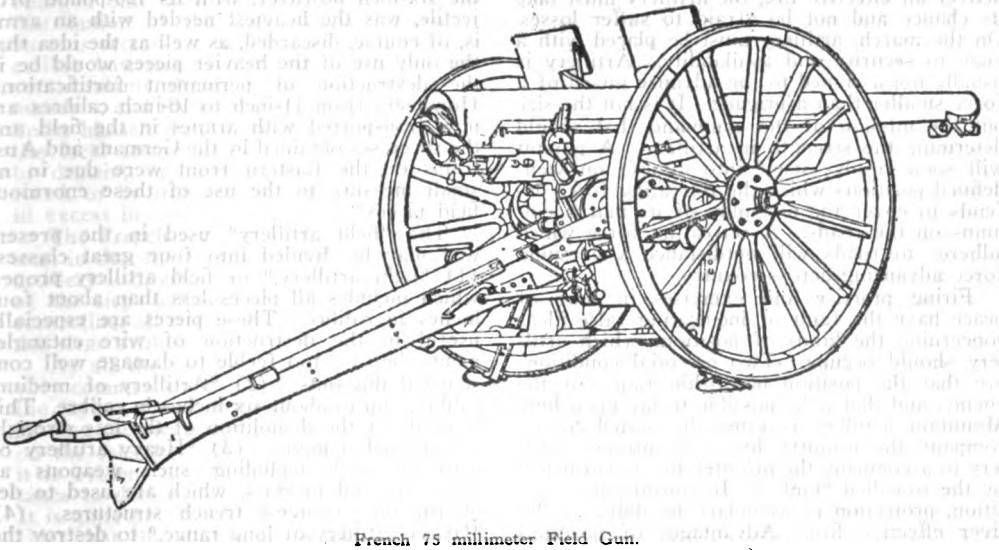


British 6-inch Siege Howitzer, Mark I*.

One of the teachings of the great European War was the indisputable necessity in the modern army of a numerous and heavy artillery. The question of type is complicated. Without excessive multiplication of calibres it was, nevertheless, necessary to have various types of heavy guns, because they all had definite functions. A review of the different calibres employed by the Germans leads to the conclusion that the modern army should have: (1) Heavy corps artillery, composed of comparatively light pieces, from 2,000 to 3,000 kg. with limber, pulled like ordinary field artillery, by six horses and able to follow the infantry in all of its movements on any ground. The light 105 mm. howitzer, model 1898, and the heavy 150 mm. howitzer, model 1905, represent this type in the German Army. These howitzers fire a projectile weighing, respectively, 15 and 40 kg. (2) Heavy army artillery, including the heaviest guns, drawn by 10 or 12 horses, weighing in general from 4,000 to 6,000 kgs., and firing from take-down platforms. In the German Army this artillery is composed of long 19 cm., 13 cm., and 15 cm. calibres, having a range between 14 and 18 kms., and also of the 21 cm. mortars, throwing a shell of 110 kgs. to a distance of nine kms. (3) Heavy siege artillery, composed of the 28 cm., 30.5 cm. and 42 cm. mortars of great range and of naval guns, mounted on trucks. This formidable artillery naturally requires motor traction.

Field Artillery.— The manner of placing artillery and its employment must be regulated by its relative importance, under given circumstances, with respect to the action of the other arms. In the defensive, the principal part is usually assigned to the artillery; and the posi-

tions taken up by the other arms will, therefore, be subordinate to those of this arm. Unless the batteries are on points which are inaccessible to the enemy's cavalry and infantry, they must be placed under the protection of the other troops, and be outflanked by them. As in the defensive, we should be prepared to receive the enemy on every point; the batteries must be distributed along the entire front of the position occupied, and on those points from which they can obtain a good sweep over the avenues of approach to it, the guns being masked, when the ground favors, from the enemy's view, until the proper moment arrives for opening their fire. The distance between the batteries should not be much over 600 paces, so that by their fire they may cover well the ground intervening between them and afford mutual support, the light guns being placed on the more salient points of the front, from their shorter range and greater facility of manœuvring; the heavier guns on the more retired points. Guns of various calibre should not be placed in the same battery. A sufficient interval should also be left between batteries of different calibre to prevent the enemy from judging, by the variations in the effect of the shot, of the weight of metal of the batteries. Those positions for batteries should be sought for from which a fire can be maintained until the enemy has approached even within good rifle-range of them. Where the wings of a position are weak, batteries of the heaviest calibre should be placed to secure them. A sufficient number of pieces — selecting for the object in view horse-artillery in preference to any other — should be held in reserve for a moment of need; to be thrown upon any point where the enemy's progress threatens danger; or to be used in covering the retreat. The collection of a large number of pieces in a single battery is a dangerous arrangement, particularly at the outset of an engagement. The exposure of so many guns together might present a strong inducement to the enemy to make an effort to carry the battery; a feat the more likely to succeed, as it is difficult either to withdraw the guns or change their position promptly after their fire is opened; and one which, if successful, might entail a fatal disaster on the assailed, from the loss of so many pieces at once. In the outset of offensive movements, good positions should be selected for the heaviest pieces, from which they can maintain a strong fire on the enemy until the lighter pieces and the columns of attack are brought into action. These positions should be taken on the flanks of the ground occupied by the assailant, or on the centre if more favorable to the end to be attained. In all cases, wide intervals should be left between the heavy batteries and the other troops, in order that the latter may not suffer from the return-fire which the assailed will probably open on the batteries. For the same reason, care should be taken not to place other troops behind a point occupied by a battery, where they would be exposed to the return-fire of the assailed. When this cannot be avoided the troops should be so placed as to be covered by any undulation of the ground, or else be deployed in line to lessen the effects of the shot. The artillery which moves with the columns of attack should be divided into several strong batteries, as the object in this case is to produce a decisive impression upon a few points of the enemy's line by bringing an overwhelming fire to bear upon these points. These batteries should keep near enough to the other troops to be in safety from any attempts of the assailed to capture them. Their usual positions will be on the flanks and near the heads of the columns of attack; the intervals between the batteries being sufficient for the free manœuvres of the other troops in large bodies. The manœuvres of these batteries should be made with promptitude, so that no time may be lost for the action of their fire. They should get rapidly over unfavorable ground to good positions for firing, and maintain these as long as possible; detaching, in such cases a few pieces to accompany the columns of attack. In all the movements of the batteries great care should be taken not to place them so that they shall in the least impede the operations of the other troops.



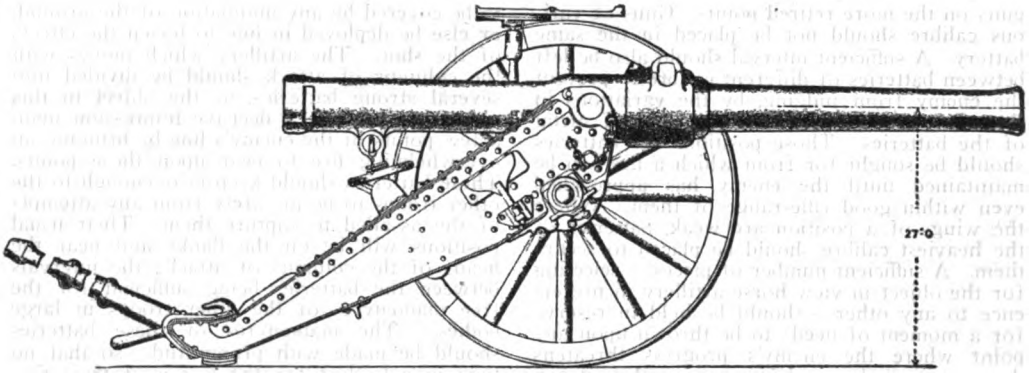
French 75 millimeter Field Gun.

The United States is the only country to maintain approximately full strength batteries in time of peace. All other nations skeletonize the firing battery for training purposes, impress teams for ammunition supply and maintain reserves. Howitzers enable a division to act independently. Before the war of 1914 the Germans with 6.4 guns had the highest percentage per 1,000 rifles; the United States with 3.1 the lowest. Nowadays the proportion is enormously greater in all armies. Artillery can easily keep up with the troops it accompanies. In advancing to position it usually moves at the trot, in occupying position at the walk or trot. It seldom moves at the gallop, but when circumstances require it gallops in line for short distances only. The average march for a battery is 15 to 20 miles per day.

The statement that a battery seen is a battery lost still holds true. In the Balkan wars behind the crest are greater mobility, ability to act by surprise, greater field of fire, hostile observation made more difficult, ammunition supply easier.

A battery occupies a front of 100 yards, a battalion 400 yards, a regiment 900 yards. Light guns are rarely placed in tiers. With howitzers or heavy guns in the second line this may be done. Firing over infantry must be considered as the normal procedure and is not dangerous. The artillery can support the infantry up to 100 yards from the hostile trenches and on the defense until the hostile attack arrives within charging distance. In offensive action the necessity of getting within suitable and effective range of the hostile positions will usually govern.

Early German successes in the European War were due in great measure to the heavy field artillery and its proper handling. The



British 10-pounder Mountain Gun (rear wheel removed).

the Bulgarians relied upon long-distance firing. The Serbians usually tried to get within 2,000 yards. At Yenidze-Yardar the Turks held up two Greek divisions by covering a bridge at 6,800 yards. As a rule rather than cross exposed areas, extreme ranges were used or darkness was awaited. In order to be able to deliver an effective fire, the artillery must take its chance and not be afraid to suffer losses. On the march, artillery must be placed with a view to security and availability. Artillery is usually not assigned to the advance guard of a force smaller than a brigade. It is not the size but the mission of the command that should determine the strength in artillery. A pursuit will soon resolve itself into attacks on well-defined positions which the retreating force defends to cover the assembly of its march columns on the roads. A retreating force which adheres to roads will outdistance a pursuing force advancing across country.

Firing practice and exercises in time of peace have the fault of inculcating false ideas concerning the kinds of positions which artillery should occupy. Two essential conditions are that the position be within range of the enemy, and that it be possible to lay upon him. Mountain artillery is especially suited to accompany the infantry line. At present artillery to accompany the infantry line is furnished by the so-called "tanks." In considering a position, protection is secondary to ability to deliver effective fire. Advantages of positions French relied upon their light "75." The German heavy artillery, using aeroplane reconnaissance, was able to destroy entire batteries of "75's" without themselves suffering any damage. The lesson is that heavy calibres and good ammunition supply give better support to the infantry, and this means success. The idea that the six-inch howitzer, with its 120-pound projectile, was the heaviest needed with an army is, of course, discarded, as well as the idea that the only use of the heavier pieces would be in the destruction of permanent fortifications. Howitzers from 11-inch to 16-inch calibres are now transported with armies in the field and the successes obtained by the Germans and Austrians on the Eastern front were due in no small measure to the use of these enormous field pieces.

The "field artillery" used in the present war may be divided into four great classes: (1) "light artillery," or field artillery proper, which includes all pieces less than about four inches in calibre. These pieces are especially useful in the destruction of wire entanglements, but are too feeble to damage well constructed dug-outs. (2) "Artillery of medium calibre," up to about six inches in calibre. This is used for the demolition of the less strongly constructed dugouts. (3) "Heavy artillery of great power," including such weapons as howitzers and mortars, which are used to demolish the strongest trench structures. (4) "Heavy artillery of long range," to destroy the

enemy's artillery, which is placed far back of the hostile line. The order given is the approximate order of the batteries from front to rear.

Siege Artillery.— An examination of the German formations for sieges indicates that their organization is based on the theories — aggressiveness, quick resolution and celerity of movement. A character of their formations is the great abundance of means provided, and especially of transportation, with a view to promptly re-enforcing any field unit charged with a siege with a large number of medium calibre batteries, completely provided with everything necessary for their separate organization, so as to make possible prompt and efficient action on their part.

Thus, many battalions of fortress artillery have a complete equipment of draught animals; the 6-inch howitzers and the 8.2-inch mortars, for example, are organized as heavy field artillery and assigned in considerable numbers to army corps. Each corps has a battalion of four four-gun howitzer batteries — either of 6-inch howitzer battalions, organized as above or else a battalion of two four-gun 8.2-inch mortar batteries.

To each battalion of fortress artillery there is assigned an ammunition company, which provides not only ammunition but also spare supplies and, to assist in furnishing the same, has as part of its equipment a narrow-gauge railway 4.7 miles long, using animal traction. Each such ammunition company has, in addition, a detachment of mechanics who relieve the batteries of much work; and, besides, it has been found that by keeping the same men constantly busy at the same kind of work, they become more proficient and render better service than do men temporarily employed on several different kinds of work.

The commandant of the field unit is the commandant of the sector, and commands not only his own troops, but all special troops assigned to the sectors. For though there is an artillery commander for the siege artillery to assist the commander-in-chief, yet, after making the necessary reconnaissances, he is charged only with advising as to the general distribution of the siege artillery among the various sectors. The employment of medium-calibre batteries is left entirely to the sector commandants, through their own artillery commanders, and the commander for siege artillery limits himself during the attack to re-enforcing the local sector artillery, as may be required, by drawing on units in reserve, or newly arrived, or by transferring artillery found to be in excess in one sector to another section.

The French regulations differ from the German in that the control of their medium-calibre artillery is directly exercised by the commander of the siege artillery, the sector commandants controlling all troops in their sectors other than the siege artillery.

As all the incidents of the siege from the very commencement of the investment, such as the laying out of lines of communication, unloading the siege material, etc., depend directly on the selection made for the point of attack, it is evident that it is of the greatest importance to decide this point as soon as possible. It is quite practicable to do this, when we consider that the studies made and data required in time of peace concerning fortresses which might become objectives for various armies, usually contain information of great importance, and that in addition preliminary reconnaissances can be undertaken by selected officers sent ahead with the advance troops, independent cavalry, advance guard, etc., who can to a certain extent complete this information in such manner as to enable the siege commander to come to a proper decision.

A decision as to the selection of the point to be attacked must be based not only on the defensive powers of the various faces of the fortress and the conformation of the terrain in their fronts, which should be such as to admit of proper deployment of the siege artillery, but should be based also on the influence which the fall of the face attacked will have on the ultimate fate of the fortress. Moreover, consideration must be given to the strategical situation and to the means of communication, which should be such as to facilitate the provision of all necessary supplies and accessories. The state of the defensive works will, of course, not be completely revealed until the attack has actually commenced and often not until it has been pushed well forward.

The general plan of the siege and the points of attack having been determined on, the various available forces and material are assigned and a general scheme of operation is decided on. It is unnecessary to determine every small detail, it being better to leave liberty in such matters to commandants of sectors, so that they may conform to the changing circumstances and incidents of the attack, as they successively develop; for the relations of the attack to the defense are constantly changing, requiring adjustment of plans for the employment of troops and siege matériel.

As to the distance at which artillery ought to be deployed, it being recognized that the nature of the ground and the construction and armament of the hostile works will be quite different in different sectors, a broad initiative is left to sector commandants, in order to permit them from the very commencement of operations the better to take advantage of favorable circumstances in advancing their siege batteries as near as possible to the fortress. The removal of vegetation from the field of fire, the capture by surprise of some advanced post of the defense, inferior conditions of observation or of fire of the defenders' batteries, may permit more progress in one zone than in another. But the possibility of such progress rarely appears at the beginning of operations, when the general plan for the artillery is decided on; it only becomes apparent as the siege progresses, and then the intervention of the commander-in-chief may embarrass and retard the prompt seizing at opportune moments of advantageous points which the local situation may permit.

There is no doubt that a large part of the losses sustained in siege warfare occur during short range fighting, in which the fire from small arms, machine guns and rapid-fire guns may become annihilating when the enemy is held under their fire for but a very few moments by some simple obstacles. Wire entanglements, ditches temporarily impassable, a wall which the artillery has previously failed to destroy or at least breach, all may cause enor-

mous losses to the attacker, who unexpectedly finds his progress stopped by such obstacles. However, one of the lessons of the present war has been that no permanent fortification, no matter how strong it may be, can hold out against the heavy artillery fire of the besiegers, and that earthworks, with dugouts far beneath the surface of the ground, which can be repaired with relative ease under hostile fire, furnish the only type of fortification which can resist the power of modern arms. The result of this has been that at present we have a use of artillery which renders it neither strictly field artillery nor strictly siege artillery, but a third kind partaking of the nature of both and primarily adapted to the warfare of positions.

Seacoast Artillery.— With few exceptions, the characteristics of the 8-inch, 10-inch and 12-inch rifles are essentially the same. The 12-inch is the gun intended to cope with capital ships carrying the heaviest guns and armor. The 14-inch gun, advocated by the United States Ordnance Department, was later designed to provide a weapon that would take the place of the 12-inch gun. The length of the gun (34 calibres) was limited so that it could, if found desirable, be used in emplacements already provided for 12-inch guns. The muzzle velocity was established at 2,150 feet per second to secure a penetration at 8,000 yards, approximately equal to that of the 12-inch 2,500 f.s. gun, while securing an accuracy life which has proved to be approximately four times as long. While the danger space is somewhat less than that of the 12-inch, 2,500 f.s. gun, the striking energy is materially greater at all ranges, and the bursting charge is approximately 50 per cent greater. Not only for coast fortifications but for the battleships as well, all countries and technical students of the subject have now committed themselves to large calibres, and at present in no situation would it be desired to have the 9.5-inch piece the weapon of maximum size and strength. It has been fully demonstrated that fire against modern armor must be perforating fire with large calibres and explosive charges of from 3.5 to 4.5 per cent of the weight of the projectile; but if at some future time, on account of an alteration in naval construction or for any other cause, the semi-perforating shell with a 10 per cent explosive charge is considered advantageous, then at that time the major calibres will still have a very great superiority. In the first place, they are able to keep the battleships at distances of from 20 to 25 km., as compared with 13 or 14 km. in the case of 240-mm. (9.5-in.) guns; moreover, a battery of two 381-mm. (15-in.), 40-calibre guns, for example, firing 1.2 shots per minute (which is the rate of fire given in tables computed by the Vickers company) will be able to hurl at the enemy 182.4 kg. of explosive in place of 240 kg., which can be thrown by a battery of four 240-mm. (9.5-in.) guns in the same length of time, while the projectiles of the former, piercing the armor before bursting, and exploding a great quantity of powder (76 kg. each time), will have a much greater effect than those of the latter, which will cause, in most cases, an inoffensive explosion against the exterior of the armor, at the same time that those which do happen to penetrate, since they carry a relatively small charge (20 kg.), will not have a very great explosive effect Major calibres are also able to utilize a short cap for this type of shell in the attack of decks of battleships thereby causing an enormous amount of damage.

The hauling of the large guns and howitzers is a difficult operation. Two of the Krupp 42-cm. guns need no fewer than 26 traction engines. Each is in four pieces (i.e. loads) and each piece is drawn by three traction engines, the spare engines going on ahead to be used as helpers up hills. The 11.2-inch Krupp howitzer travels on a special wagon, the cradle is converted into a carriage by putting a pair of wheels on the cradle trunnions, which are central; and the trail and wheels for a third carriage, 4½ girdles, weighing one-half ton each, travel when not in use, on a girdle wagon, weighing four tons gross. The high elevation, namely 65°, of which this howitzer is capable is intended to allow it to be fired with full charge at short ranges, so as to obtain a high remaining velocity and steep angle of descent.

Recent increase in range and power of guns is more in favor of an attacking fleet than of the fixed defenses ashore, for several reasons. First, it gives the attack a greater choice of positions from which to attack, not only because the area over which the attack can operate naturally increases with the length of range at which they can attack, but also because, when restricted to short ranges, ships would also in all probability be confined to certain channels, on account of shoals and banks lying near shore, and these channels — possibly narrow and intricate of navigation — could also be mined. Thus, a fleet armed with modern guns has a greater choice of positions; it could, for instance, take up an enfilading position from which perhaps only one gun of a shore battery could bear, and could more easily bring the concentrated fire of several ships on to one work. This relative advantage of attack over defense would hold good even if the increase in power and range of the defense guns had kept pace with that of naval guns; but it never has and never will.

Again, the increased protection given to modern ships, and the possibilities of observation of fire conferred on them by the introduction of airships, very largely detracts from the advantage hitherto enjoyed by shore defenses of being less vulnerable and of possessing greater facilities for observation of fire than their adversaries.

Also the good effect of increased range in the gun is limited at night by the effective radius of illumination of electric lights, and may be limited by day by atmospheric conditions; and this neutralized the advantages of long-range guns to the defense in certain forms of attack, as, for instance, in the case of a mine-layer laying mines in a channel of approach beyond efficient electric light limit. Long range guns would be powerless to prevent this. Again, under cover of a fog a ship or squadron might approach to within medium range; the defense would lose all the advantage of long range by being unable to attack during the approach, while at a medium range the greater number of guns probably carried by the attack would enable it to overwhelm and smother the defense. But great as has been the development of guns, the development of torpedoes in speed, range and accuracy has

been as great, if not greater. The advent and development of the submarine has done still more to increase the power of the torpedo as an offensive weapon, and on the whole this development of the torpedo is in favor of the defense.

It would, therefore, seem probable that the future development of coast defense would lie in increasing the number and efficiency of defense flotillas of torpedo boats and submarines, rather than in the size and number of the guns on fixed mountings ashore. The gun cannot altogether disappear, there must always be a last entrenchment — a keep; and that keep will be the shore batteries.

One of the greatest lessons learned in the European War is the increased importance of heavy mobile artillery, and the necessity for devising plans to use effectively sea-coast armament and designing mounts for howitzers and mortars to permit them to be easily transported and quickly mounted. Whatever the design, it should fulfil the following requirements: (1) It should be mobile and capable of being transported quickly either by railroad on flat cars or by gasoline tractors over ordinary roads. (2) It should be capable of being mounted quickly on a concrete emplacement of simple design. (3) It should be more powerful than any similar weapon that can be brought against it. (4) In addition to being equipped with the ordinary telescopic sight, it should be practicable to lay it in azimuth and range as is done with the present type of sea-coast mortars. In drawing up a project for the defense of a locality on the sea-coast, sites for mobile howitzer batteries should be selected for defense against attack from the land side. The emplacements for these batteries might be constructed in time of peace or upon the outbreak of war. Each coast defense should be equipped permanently with one or more of these batteries to supplement the fixed armament and for the purpose of training coast artillery companies in their use. See AMMUNITION; ARMOR PLATE; COAST DEFENSE; FORTIFICATIONS; GUNNERY; HORSE ARTILLERY; LIGHT ARTILLERY; MOUNTAIN ARTILLERY; ORDNANCE; and PROJECTILES.

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ARTILLERY COMPANY, The Ancient and Honorable, a military organization of Boston, Mass. It was copied from that of London, was formed in 1637 and was the first regularly organized military company in America. The company hold their drill in Faneuil Hall, Boston.

ARTILLERY COMPANY, The Honorable, the oldest existing body of volunteers in Great Britain. It was instituted in 1537 and comprises six companies of infantry, besides artillery, gernadiers, light infantry and yagers. It furnishes a guard of honor to the sovereign when visiting London. The King is "Captain-General and Colonel" of the force.

ARTILLERY CORPS, the official name of the entire artillery service of the United States army.

ARTILLERY PARK. A collective name given to the whole of the guns, carriages, ammunition and other appurtenances essential to the working of siege or field-artillery. Besides reserve guns and carriages there belong to it the ammunition wagons, as well for the infantry and cavalry as for the artillery, the implements and materials necessary for repairing and completing equipments, harness-stores, field-forges, laboratories and (in some armies) transport and provision wagons. The personnel of a park of artillery consists of artillery officers, non-commissioned officers and artillerymen, besides a large number of smiths, wheelwrights, saddlers, armorers, drivers and other mechanics and laborers. Sometimes the term is applied to the place selected as well as the vast military stores collected there.

ARTILLERY SCHOOLS are institutions established for the purpose of giving a special training to the officers and in some cases the men belonging to the artillery service. See MILITARY EDUCATION.

ARTIODACTYLA the suborder of ungulate mammals in which the central (and in some cases the only) pair of toes in each foot are arranged symmetrically on each side of a vertical line running through the axes of the limbs.

ARTIST'S LETTERS FROM JAPAN, An, a work by the noted American artist, John La Farge. The drift of the book is toward a purer art; but it contains much lively matter,— accounts of the butterfly dance in the temple of the Green Lotus, and of fishing with trained cormorants. A thread runs through the letters, tracing the character and progress of the usurping Tokugawa family, from the cradle of their fisherman ancestors to the graves of the great shogun and his grandson in the Holy Mountain of Nikko.

ARTOCARPUS, the generic name of the bread-fruit tree (q.v.).

ARTOIS, ār'twä', the name of a former province of France anciently one of the 17 provinces of the Netherlands. It was bounded on the south and west by Picardy, on the east by Hainault and on the north by Flanders. It is now almost completely included in the department of Pas de Calais. Artois is a fertile region, producing grain and hops. Its capital was Arras. The district was the scene of some of the most desperate fighting in the European War.

ARTOTYPE. See PHOTOGRAPHY.

ARTS, the designation of branches of study in the Middle Ages, originally called the

liberal arts to distinguish them from the servile arts or mechanical occupations. These arts were usually classed as grammar, dialectics, rhetoric, music, arithmetic, geometry and astronomy. Hence originated the terms "art classes," "degrees in arts," "master of arts," still in common use in universities, the faculty of arts being distinguished from those of divinity, law, medicine or science.

ARTSYBASHEV, Mikhail Petrovitch, maternal great-grandson of Kosciusko, Russian writer: b. 1878. Like many of the Little Russians, he is of mixed descent, being of Tartar and Polish as well as of Slavic blood. As a boy he studied painting, but later he turned to short-story writing and when his first story was published he was so encouraged as to determine to make a career of literature. At the age of 25 he wrote his first long work, a novel called 'Sanin' (1907), which at once gained him a national reputation. Like Gorky and Andreyev and other Russian writers of the modern school, his writings show the revolutionary tendency of present-day Russia in their frank, almost brutal, treatment of the realities of life.

ARTUSI, är-too-sĕ, **Giovanni Maria,** musical writer and composer: b. Bologna 1550; d. 18 Aug. 1613. He was a canon of San Salvatore, in Venice, and extremely conservative in his stand against the progressive tendencies of Gabrieli and Monteverde and other radicals of that school, whom he attacked vigorously. His works are 'L'Artusi, ovvero delle imperfezioni della moderna musica' (Venice 1600); 'L'arte del contrappunto' (Venice 1589). Among his compositions are a 'Canzonette' for four voices and a 'Cantate Domino,' to be found in the Vincenti collection.

ARU. See ARRU ISLANDS.

ARUBA, or **ORUBA,** ä-roo'ba, a Dutch island of the Antilles, west of Curaçao, of which it is an administrative part. It is extremely mountainous and abounds in phosphate deposits. Gold, too, is found in sufficient quantities to warrant mining operations. Its area amounts to about 70 square miles with a population of 10,000, most of which is concentrated about Oranjestadt, the capital.

ARUM, a small genus of tuberous tropical and subtropical perennial herbs (commonly called callas) of the natural order *Araceæ*, with simple leaves and diversely colored convolute spathes, for which they are cultivated either under glass or, in the case of some hardy species, in the open air, as ornamental plants. The naked topped spadices bear staminate flowers just above the pistillate ones at the bases. The tender species are managed like the fancy-leaved caladium (q.v.); the hardy must be planted in rich soil in cool, moist situations and must be well mulched during the winter. *A. maculatum,* lords-and-ladies, cuckoo-pint, wake-robin, from Europe, is, with its many cultivated varieties, perhaps the best known hardy species grown in America. The leaves and corms are acrid; but the latter when ripe contain starch which may be extracted and used as a food. In places where it abounds it has long been converted into a kind of arrow-root and has been proposed as a substitute for the potato, but the corms are too small for profitable culture. Some closely related native American plants of somewhat similar habit are skunk cabbage (q.v.), water calla (see CALLA), Indian turnip (see JACK-IN-THE-PULPIT). The Arum lily (*Richardia æthiopica*) is an arad with a pure white spathe and brilliant yellow spadix; a favorite drawing room flower. *Anthurium,* a well-known genus of greenhouse plants, is also nearly allied.

ARUNDEL, ăr'-ŭn-dĕl, **Thomas,** an English prelate, third son of Richard Fitz-Alan, Earl of Arundel: b. Sussex 1353; d. Canterbury, 19 Feb. 1414. He became Archdeacon of Taunton (1373) and Bishop of Ely in August of the same year. In 1388 he was transferred to the archbishopric of York. He was Chancellor of England from 1386–89, and from 1391–1396, and Archbishop of Canterbury in 1396. He concerted with Bolingbroke to deliver the nation from the oppressions of Richard II, for which he was banished from England. On going to Rome he was very favorably received by Boniface IX, who later deprived him of his see and transferred him to Saint Andrews in Scotland. He returned in 1399 and was reinstated at Canterbury. He crowned Henry IV and served as Lord Chancellor for a few days. He persecuted the Lollards and was a chief instrument in procuring the act for the burning of heretics. He also procured a synodal constitution which forbade the translation of the Scriptures into the vulgar tongue.

ARUNDEL, Thomas Howard 2d earl of: b. Essex 1586; d. 1646. An English art collector, the first to make any large assemblage of works of art in England. He received his education at Trinity College, Cambridge, and in 1616 was appointed a Privy Councillor and in 1621 Earl Marshal of England. In 1636 he executed an important diplomatic mission at the Court of Vienna. See ARUNDEL SOCIETY; ARUNDELIAN MARBLES.

ARUNDEL, England, a small town in Sussex, famous as containing Arundel castle, the family seat of the dukes of Norfolk. It is on the small river Arun and has a showy Roman Catholic cathedral erected by the Duke of Norfolk. Pop. (1911) 2,842.

ARUNDEL HOUSE, on the Strand, London, the residence of Lord Arundel, where the Arundelian Marbles (q.v.) were housed. Another Arundel House, less known, was that in which Lord Bacon died and which stood near Highgate.

ARUNDEL SOCIETY, a society instituted in London in 1848 for promoting the knowledge of art by the publication of facsimiles and photographs. It was named for the collector of the Arundelian Marbles.

ARUNDELIAN MARBLES, a series of sculptured marbles discovered by William Petty, who explored the ruins of Greece for Thomas Howard, Earl of Arundel, in the reign of the first Stuart kings, James I and Charles I, and devoted a large portion of his fortune to the collection of monuments illustrative of the arts and of the history of Greece and Rome. These marbles arrived in England in the year 1627 with many statues, busts, sarcophagi, etc. John Selden published some of the inscriptions which he thought most interesting,

under the title of 'Marmora Arundeliana' (1628). Henry Howard, Duke of Norfolk, grandson of the collector, presented them in 1667 to the University of Oxford, where they still remain. The whole collection of inscriptions was published by Humphrey Prideaux in 1676; by Michael Maittaire in 1732; by Chandler in 1763. These inscriptions are records of treaties, public contracts, thanks of the state to patriotic individuals, etc., and many of a private nature. The most curious and interesting is one usually known by the name of the Parian Chronicle, from having been kept in the Island of Paros. It is a chronological account of the principal events in Grecian, and particularly in Athenian history, during a period of 1318 years, from the reign of Cecrops (1450 B.C.) to the archbishop of Diognetus (264 B.C.). The authenticity of this chronicle has been called in question, but has been vindicated by many of the most learned men. The best edition is that of Boeckh, with a full Latin commentary in 'Corpus Inscriptionum Græcarum' (Berlin 1828–77); the new fragment is published in 'Mitteilungen des kaiserlich-deutschen archäologischen Instituts, Athenesche Abteilung (Vol. XXIV, Berlin 1897). Consult Sandys 'A History of Classical Scholarship' (Vol. II, pp. 342–343, Cambridge 1908).

ARUSPICES, Roman priests and prophets, who foretold events from inspection of the entrails of sacrificed animals. They observed, too, all the circumstances which accompanied or happened during the sacrifice; for example, the flame, the mode in which the animal behaved, the smoke. The origin is to be sought for in Etruria. They were introduced into Rome by Romulus, where they flourished till the time of the Emperor Constantine (337 A.D.), who prohibited all soothsaying on pain of death.

ARUSPICES, ON THE REPLY OF THE, an oration by Cicero. After Cicero's recall from exile different prodigies alarmed the people of Rome. The aruspices being consulted, answered that the public ceremonies had been neglected, the holy places profaned and frightful calamities decreed in consequence. Thereupon Clodius denounced Cicero as the cause of the misfortunes that menaced the city, and on the following day the orator replied in the Senate to the attack. The speech takes rank among the greatest of Cicero's orations, though he had little time for preparation and suffered under the disadvantage of addressing an audience at first openly unfriendly.

ARUWIMI, ä'roo-wē'me, (1) a river of equatorial Africa having its source in the hills to the west of Albert Nyanza and tributary to the Kongo. Its length is a little over 800 miles and its breadth at its confluence with the Kongo is about a mile. It is navigable up to Yambuya, but beyond that place there are many rapids. In its upper course it is called the Ituri. Stanley discovered its mouth in 1877 and traced a considerable part of its course in his search for Emin Pasha in 1887. (2) One of the 16 districts into which the Kongo Free State is divided.

ARVAL BROTHERS, or **ARVA'LES FRATRES,** a Roman college of priests, 12 in number, whose duty it was to offer sacrifices for the fertility of the fields. That they were of extreme antiquity is proved by the legend which refers their institution to Romulus, of whom it is said that when his nurse Acca Sarentia lost one of her 12 sons he allowed himself to be adopted by her in his place and called himself and the remaining eleven «Arvales Fratres.» In 1570 at the place called Affoga l'Asino, a little beyond the fifth milestone on the Via Portuensis, inscriptions were found sufficient to identify the spot as the grave of the Dea Dia where the chief festival of the Arvales was held. We have now the protocols of 96 annual meetings dating from 14 A.D. to 241, and a list of officers dating from 2 B.C. to 27 A.D. From the time of Augustus it became usual to appoint princes of the imperial family as extra members. The members were elected for life by the college, usually on the nomination of the emperor. The officers were a magister, who presided; the flamen, who assisted in the sacrifices, and four boys whose parents were living and who were sons of senators, were the attendants. The college had also its staff of servants. The officers wore as a sign of office a chaplet of ears of corn fastened about their head with a white band. The principal duty of the Arvales was to celebrate a three-days' festival in honor of the Dea Dia, formerly supposed to be Ceres, but now more correctly identified with Ops; the divinity of Ceres, as Marquardt observes, not forming a part of the old Roman worship. The feast was celebrated by offerings to the goddess and the «touching» or consecrating of the grain, on the first day. On the second, two pigs, a white heifer and a sheep were sacrificed in the sacred grove, while two of their number collected grains of corn in earthen bowls, probably from the crowd at the temple door; after which the brethren performed the sacred song and dance within the temple and officers were elected for the coming year and there were races in the grove. The third day was celebrated by a sacrifice in the city. The other duties of the Arvales were to pronounce solemn vows for important events in the imperial family — the birthday, marriage, illness or recovery of the emperor, his setting out or returning from serious undertakings, etc. The Ambarvalia, according to the best opinion, were entirely separate from the functions of the Fratres Arvales. The documents with a valuable commentary were published by Gaetano Marini (2 vols., Rome 1795). Consult Henzen, 'Acta Fratrum Arvalium' (Berlin 1874); Brown, 'Rome and the Campagna' (p. 440); Preller, 'Römische Mythologie' (pp. 422–430); and Marquardt (Vol. VI, 428–443).

ARVE, ärv, a river tributary of the Rhone, which it enters near Geneva after a course of about 50 miles. It flows through the valley of Chamouni and many of the most famous resorts of Switzerland are found in its vicinity.

ARVEYRON, a river in the department of Haute-Savoie, France, having its rise 4,400 feet above sea-level in the Alps and emptying in the Arve.

ARWIDSSON, är'-vĕd-sŏn, **Adolf Ivar,** Swedish poet: b. Padasjoki, Finland, 7 Aug. 1791; d. Viborg, 21 June 1858. He studied at the University of Åbo and in 1817 was appointed docent of history in the same institution. The strong critical stand he took against the uni-

versity authorities caused his dismissal in 1822, and not long after, because of an essay he had published, he was banished by the government and compelled to seek refuge in Sweden. In Stockholm he found a position in the Royal Library, of which he became director in 1843. His chief work, 'Svenska fornsånger' (Stockholm 1834–42), is a collection of old Swedish folk lore and songs. His original poems appear under the title 'Ungdoms rimfrost af sonen i örnskog' (Stockholm 1832). His other works are 'Svenska konungar och deras tidehvarf' (1830–43); 'Stockholn före och nu' (1837–40); and a translation of the Icelandic 'Frithiofsaga' (2d ed. 1841).

ARYA SOMAJ, a religion founded in India by Swami Dayanand Sarasavati (1824–83); 10 April 1875 is the date of the founding of the cult at Bombay. The official creed was in the form of a decalogue. Their doctrine of Niyoga is practically that of free-love. The government is by the local congregation, the Provincial Synod and the General Synod for all India. While it comes from Hinduism it is largely an eclectic religion and borrows from other religions. It is missionary in character and follows the methods of the Christian missionary societies. Its membership is estimated at more than 100,000. It lays great emphasis on education and social reform. The sect has a college at Lahore.

ARYABHATTA, är'-ya-b'hät'ä, Hindu astronomer and mathematician of the 5th century: b. 476 A.D. His only known work, the 'Aryabhattiya,' is a mathematical treatise in verse; frequent reference is made to his writings by later Hindu scholars. In the solution of quadratic equations and the application of algebra to geometry and astronomy he anticipated some of the discoveries of modern algebra. He also announced the correct theory of the diurnal rotation of the earth and the correct explanation of solar and lunar eclipses See ALGEBRA, HISTORY OF.

ARYAN (är'yan, or är'-ĭ-an) **LANGUAGES,** an important language family frequently styled the Indo-European or Indo-Germanic family of tongues. They have reached a higher development than those of the second great family, the Semitic, and are far in advance of the next one — that comprising the Turanian tongues. Like the Syro-Arabian forms of speech they are inflectional; while those of Turanian origin are only agglutinate. Max Müller separated the Aryan family of languages primarily into a southern and a northern division. The former is subdivided into two classes: (1) The Indic; and (2) the Iranic; and the latter into six: (1) The Celtic; (2) the Italic; (3) the Illyric; (4) the Hellenic; (5) the Windic; and (6) the Teutonic. It is often said that Sanskrit, spoken by the old Brahmins, is the root of all these classes of tongues. It is more correct to consider it as the first branch and assume the existence of a root not now accessible to direct investigation. Students and experts in Aryan language claim that the entire structure is developed out of monosyllabic elements, usually called roots. These were of two classes, predicative or verbal, indicating action or quality; and demonstrative or pronominal, indicating position or direction. By the combination of these two, especially, were grammatical forms made and parts of speech distinguished. The addition of pronominal endings to verbal roots made a verbal tense in three numbers (the dual perhaps of later origin than singular and plural, and mostly lost again in the later languages) with three persons in each. The prefixion of an "augment" (doubtless a pronominal adverb, meaning "then") made of this a past tense; but this augment-preterite has left only scanty and doubtful relics, except in Indo-Persian and Greek. Another past tense, or perfect, was formed by reduplicating the roots, apparently to signify completed action. This is the origin of the Greek and Latin perfects, our ("strong" or irregular) preterite, etc. Futures were made later, with auxiliary verbs. Into the declensional inflection of nouns, adjectives and pronouns was introduced the distinction of sex; first by the special characterization of a feminine; later, by the additional separation of a neuter. In later history of the family primitive structure of Aryan language has been variously modified, reduced and added to. It was most fully and distinctly preserved in the Sanskrit, which on that account casts most light upon the common history of all; but there are points in which each branch leads the rest. As an illustration of the affinity among the Aryan tongues the common word daughter may be instanced. It is in Swedish, *dotter;* Danish, *datter;* Dutch, *dochter;* German, *tochter;* Old Hebrew German, *tohtar;* Gothic, *dauhtar;* Lithuanian, *duktere;* Greek, *thygater;* Armenian, *dustr;* Sanskrit, *duhitri;* the last-named word signifying primarily "milkmaid," that being the function in the early Brahman or Aryan household which the daughter discharged. Not only are the roots of very many words akin throughout the several Aryan tongues, but (a more important fact) so also are the inflections. Thus the first person singular of a well-known verb is in Latin, *do;* Greek, *didomi;* Lithuanian, *dumi;* Old Slavonic, *damy;* Zend, *dadhami;* Sanskrit, *dadami;* and the third person singular present indicative of the substantive verb is in English, *is;* Gothic, *ist;* Latin, *est;* Greek, *esti;* Sanskrit, *asti.*

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ARYAN RACE, a name sometimes applied to that particular ethnological division of mankind otherwise called Indo-European or Indo-Germanic, but more properly to the Indo-Iranian group alone. The Indo-European division includes two branches, the western, which comprises the inhabitants of Europe, with the exception of the Turks, the Magyars of Hungary, the Basques of the Pyrenees, and the Finns of Lapland, and the eastern, which comprehends those of Armenia, Persia, Afghanis-

tan and northern Hindustan. From a multitude of details it has been established that the original mother tongue of all these peoples was the same. It is supposed that the Aryan nations were at first located somewhere in central Asia, probably east of the Caspian and north of the Hindu Kush and Paropamisan mountains. From this centre successive migrations took place toward the northwest. The first swarm formed the Celts, who at one time occupied a great part of Europe; at a considerably later epoch came the ancestors of the Italians, the Greeks, and the Teutonic people. The stream that formed the Slavonic nations is thought to have taken the route by the north of the Caspian. At a later period the remnant of the primitive stock would seem to have broken up. Part passed southward and became the dominant race in the valley of the Ganges, while the rest settled in Persia and became the Medes and Persians of history. It is from these eastern members that the whole family takes its name. In the most ancient Sanskrit writings (the Veda) the Hindus style themselves Aryas, the word signifying "excellent," "honorable," originally "lord of the soil."

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AR'ZACHEL, Jewish astronomer: born in Spain about 1050. He discovered the obliquity of the ecliptic and compiled certain astronomical tables known as the "Toledo Tables," on which two centuries later were based the famous "Alphonsine Tables."

ARZAMAS, är'zā-mas, manufacturing town in the Russian government of Nijni-Novgorod, situated on the right bank of the Tiesha, 250 miles east of Moscow. It contains 34 churches, several convents and schools, 19 tanneries, several soap-works, linen factories, etc., and has a considerable trade. Pop. about 12,400.

AS, a word which the Romans employed in three different ways: to denote (1) any unit whatever considered as divisible; (2) the unit of weight, or the pound (*libra*); (3) a coin. The *as,* whatever unit it represented, was divided into 12 parts, or ounces (*unciæ*). Scholars are not agreed on the weight of a Roman pound, but it was not far from 237.5 grains avoirdupois, or 327.1873 grammes, French measure. In the most ancient times of Rome the copper coin which was called *as* actually weighed an *as,* or a pound, but in 264 B.C. was reduced to two ounces, in 217 to one ounce, and in 191 to one-half ounce. In 269 B.C., when silver money was first struck by the Romans, the *as* was superseded as a money of account by the sestertius coined from the more precious metal.

AS A MAN THINKS. In 1907, Augustus Thomas produced his play, 'The Witching Hour,' different from any work he had previously done. It was more intellectual, more concerned with ideas; it was a departure from the drama of mere situation. Its central theme was telepathy, hypnotism; and Mr. Thomas maintained cleverly, theatrically, this theme from one end of his play to the other. His interest in psychic forces was further the central motive in his next play, 'The Harvest Moon,' produced in 1909. Here the influence of mental suggestion was the theme, and, though the play was less powerful than its predecessor in its theatrical effectiveness, it revealed Mr. Thomas still concerned with the phenomena of mind.

Undoubtedly these two plays influenced the writing of 'As a Man Thinks.' When it was produced in New York, at the 39th Street Theatre on 13 March 1911, it showed the same psychological purpose, and impressed the audience with the fact that whatever Mr. Thomas was in the past, or might be in the future, at that moment he was passing through the phase of challenging thinker and teacher. In 'The Witching Hour' and 'The Harvest Moon' he held to one theme; but 'As a Man Thinks,' strong in its human quality, skilful in its construction, and brilliant in the French quality of its dialogue, is marred by diffuseness of purpose. For each act of this play is indicative of new intellectual interests in Mr. Thomas. Is the central theme of 'As a Man Thinks' a discussion of the double moral standard society maintained in 1911 A.D. for men and women? Is it the question of intermarriage between Jew and Gentile and the reasons for race hatred? Is it a rendering of New Testament ethics, and again the mental suggestion of the previous play, 'The Harvest Moon'? Mr. Thomas does not answer us. Or rather, he was not certain in his own mind, while writing this play, which interest was the greatest. The consequence is, 'As a Man Thinks' is marred by overabundance of material; its claim to interest is due to the skilful workmanship which makes of the Jewish doctor a human personality, apart from being a mouthpiece for the dramatist's preachment.

No one story runs through 'As a Man Thinks.' The Jewish doctor preaches Christian ethics to a man who has deceived his wife, and in turn has been challenged by her. Yet the doctor is crushed when his daughter marries a Gentile. The Christian wife morally defies her Christian husband by throwing to the winds the conventional moral discretion which he has discarded many times, but no special plea is convincingly given for the adoption of one moral standard for both. Intellectually, Mr. Thomas merely skims, in each act, over a different motive, in itself important enough for an entire play. It is his technical ability and the interest he creates in his characters which makes 'As a Man Thinks' a worthy drama, if not one with full literary distinction. It was published in 1911.

MONTROSE J. MOSES.

AS IT WAS WRITTEN, the title of a romance by Sidney Luska (Henry Harland), the scene of which is laid in modern New York. Sombre and tragic though it is, the romance shows unusual vigor of conception and execution and extraordinary intuitive knowledge of the psychology of the Jewish race.

AS THE LEAVES ('Come le foglie'). Giuseppe Giacosa (1847–1906), one of the three

or four great playwrights of modern Italy, began as a romanticist but gradually fell beneath the spell of the social and domestic drama developed in France by Augier and the younger Dumas, and in Norway by Björnson and Ibsen. 'As the Leaves,' produced in 1900, seems consciously reminiscent of Björnson's 'A Bankruptcy,' first played in 1874. Both exhibit a family grown corrupt through wealth and shaken by its loss. Whereas Björnson is characteristically optimistic in emphasizing the regeneration of the Tjälde family through work, Giacosa depicts rather the inability of the Rosanis to cope with poverty. Giovanni Rosani finds that he has never stiffened the will of those dependent upon him, and that, in consequence, they are blown hither and thither "as the leaves" by gusts of misfortune. His second wife lies, steals and succumbs to her fancy for a fellow artist. His son turns to gambling and consents to marry a disreputable woman in order to pay a debt. His more worthy daughter struggles in vain to uplift the others and to earn a livelihood by teaching until, discouraged, she plans to take her life. But her father and the lover, her cousin, whom she has disdained, both intercept her. At last she understands the worth of this self-made cousin who alone has endeavored to assist the family in distress. She will marry him, since he at least has learned in the school of adversity to be self-sufficient. The moral purpose of the dramatist is obvious here, although not unduly accentuated. His interest lies in character rather than in plot. 'As the Leaves' has been successful upon the stage in Italy and France, and it may be read in English in an anonymous version printed in *Drama* (1911) and in a translation by Edith and Allan Updegraff (1913) of three of Giacosa's plays.

FRANK W. CHANDLER.

AS YOU LIKE IT. The joyous and romantic comedy, 'As You Like It,' was never more happily characterized than by Robert Louis Stevenson in one of his letters: "My view of life is essentially the comic; and the romantically comic 'As You Like It' is to me the most bird-haunted spot in letters. . . . To me these things are the good: beauty, touched with sex and laughter; beauty with God's earth for the background. . . . The comedy which keeps the beauty and touches the terrors of our life (laughter and tragedy-in-a-good-humor having kissed), that is the last word of moved representation; embracing the greatest number of elements of fate and character; and telling its story, not with one eye of pity, but with the two of pity and mirth." The tone of the play, its atmosphere, the principal characters, and the genial criticism of life which pervades their words, are all suggested in these words and scarcely need further comment.

From internal evidence — the quotation of one of Marlowe's lines from the latter's 'Hero and Leander,' published in 1598 — and from external evidence — an entry in the Stationer's register in 1600 — the date of the play is generally agreed to be 1599 or 1600. This date fits in admirably with the chronological order of Shakespeare's plays, which would indicate that at the end of the period of his historical plays and his comedies and just before he entered on the period of his great tragedies, he found refreshment in this comedy and in 'Twelfth Night' and 'Much Ado about Nothing.' It is not fanciful to say that "he turned with a sense of relief and a long easeful sigh from the oppressive subjects of history, so grave, so real, so massive, and found rest and freedom and pleasure in escape from courts and camps to the Forest of Arden." In this play we are conscious of "a sunlight tempered by forest boughs, a breeze upon his forehead, a stream humming in his ears."

For the story in its main outlines and even for much of the language, Shakespeare was indebted to Lodge's 'Rosalynde' (1590). A comparison of the prose romance and the play reveals the fact that the dramatist was indifferent as to his appropriation of material; his main idea being to create a play — the play's the thing. To this end he visualized the characters, arranged them in contrasted groups or types, introduced new characters such as Corin, Touchstone, Audrey and Jaques, and made an organic structure out of what was incoherent and desultory.

The pastoral story or drama had its origin in the tendency — first in Italy and then in England — to escape from the life of the city or court into a sort of Arcadia or ideal world of happiness. The main features of the pastoral drama, the more artificial character of which is parodied in the Sylvius and Phebe scenes, are combined in 'As You Like It' with the more distinctively English ideals of free and rural life, such as may be found in the Robin Hood ballads and the dramatized forms thereof. The careless, happy life of foresters and freebooters is everywhere manifest. The forest of Arden, despite the presence of tropical plants and animals, has many of the aspects of the forests in which Shakespeare wandered as a boy; and the figures of an artificial Arcadia are balanced by the sun-burnt maids and men of the soil. In a word, he has recurred to the old tale of English outlawry and vengeance which had been modified to suit the demands of the Italian pastoral. One of the chief sources of delight in the play is the three lyrics, "Under the Greenwood Tree," "Blow, Blow, Thou Winter Wind," and "It was a Lover and his Lass." In no other play does one get a better idea of the wave of melody that swept over England in the Age of Elizabeth — a time when "tinkers sang catches, milkmaids sang ballads and carters whistled." The songs represent that perfect blending of poetry and music — the first fine careless rapture of English song which has never been recaptured. Another feature of the play is the large number of popular quotations such as the Duke's summing up of the uses of adversity, the seven ages of man as characterized by the somewhat cynical Jaques, Rosalind's description of the marks of a lover and many other passages and phrases that have become proverbial. But these passages are after all subsidiary to the characters who utter them — all of them drawn to the life. Among all these Rosalind stands out as the entrancing, commanding personality. Her brightness, joyousness, her happy nature, "mount and sing like a bird let loose from a cage." "The wild-wood freedom of the forest is in her heart, its beauty in her eyes, its summer in her temper." She is the central figure

throughout the play and at the end naturally plays the rôle of Providence in setting all things right.

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ASA, 3d king of Judah. During the first 10 years of his reign his kingdom enjoyed peace and prosperity, but in the 11th year he was attacked by the Ethiopian king Zerah at the head of a vast army, which he completely routed. On his triumphant return Asa was met by the prophet Azariah, who encouraged him to persevere in the extirpation of idolatry. In the 36th year of Asa's reign Baasha, king of Israel, occupied Ramah and proceeded to fortify it as a frontier barrier. Asa called in the aid of Benhadad, king of Syria, and recovered the city, but incurred the rebuke of the prophet Hanani for seeking help elsewhere than from the Lord. The incensed king threw the prophet into prison. He died after a prosperous reign of 41 years.

ASABA, ą-sä'bą, a town in west Africa, (Nigeria) on the Niger River, 150 miles from the coast. It is the seat of the Supreme Court and contains the central prison, civil and military hospitals and other public buildings. It was the seat of the Royal Niger Company. Near Asaba large deposits of lignite were discovered in a mineral survey of southern Nigeria. The town has grown rapidly in the last decade and is now an important commercial centre.

ASAFŒTIDA is a gum resin obtained from the root of *Ferula fœtida*. Although the United States pharmacopœia limits the producing plant, it is quite probable that asafœtida is obtained from two or even three or four species of *Ferula, F. narthex, F. fœtidissima, F. jaschkeanum*. The main sources, however, are *F. fœtida* and *F. narthex*. These are coarse herbs of the *Umbelliferæ* family distributed throughout the eastern Asiatic provinces from Persia, Turkestan, Afghanistan. The root is cleaned from the leaves and while growing is cut off close to the ground. This is then covered with leaves and in five or six weeks a slice is cut off, and from the cut surfaces the juice exudes. This juice has an overpowering odor, which much resembles that of garlic. This on thickening forms the asafœtida of commerce. The chemical composition is complex. It consists of resin, gum, ethereal oil, vanillin and ferulaic acid. Asafœtida is highly prized in the East as a seasoning. In medicine it is stimulant to the sympathetic nervous system and is an excellent carminative stimulant and antispasmodic. It is particularly valuable in expelling flatus from the peristalsis it induces. It is also used in hysteria, but in an empirical fashion.

ASAKAWA, ä'sä-kä'wä, **Kwan-ichi**, Japanese-American anthropologist; b. Nihonmatsu, Japan, 20 Dec. 1873. After graduating from Waseda University in Tokio he came to the United States to continue his studies at Dartmouth College and Yale University. For several years he was lecturer on the history and civilization of east Asia at Dartmouth College. In 1906 he returned to Japan, where he was appointed professor of English at Waseda University. Here he remained only a year, however, when he returned to the United States to accept an appointment as instructor in the history of Japanese civilization at Yale University, becoming assistant professor in 1910. Author of 'The Early Institutional Life of Japan' (1903); 'The Russo-Japanese Conflict: Its Causes and Issues' (1904); 'Notes on Village Government in Japan after 1600' (1910); 'Origin of Feudal Land-Tenure in Japan' (1914); concluding chapters in the new edition of 'Japan,' edited by Capt. F. Brinkley (1904); edited 'Japan' in the 'History of the Nations Series' (1907).

ASAM, ä-säm, **Hans Georg**, father of a famous family of Bavarian artists: b. 1649; d. 1711. He was a teacher of architecture at Prague. Notable among his works are his frescoes in the churches at Benediktbeuren and Tegernsee. His son, COSMAS DAMIAN: b. 1680; d. 1742, was also a painter of high rank. Another son, ÆGIDIUS QUIRINUS: d. about 1746, was a sculptor who studied at Rome and settled in Munich in 1715. Their works in common were the cathedral of Freising, which they completely remodeled; the decoration of the monasteries of Maria-Einsiedeln and Metten and the church of Saint Emmeram at Ratisbon; the building of the Congregational Hall at Ingolstadt and the church of Saint John. Their own residence was another of their architectural works which is considered one of the best examples of the Baroque school of architecture in Germany.

ASAMA-YAMA, ä-sä'mä-yä'mä, an active volcano of Japan about 50 miles northwest of Tokio, 8,280 feet high. Its latest destructive eruption was in 1783.

ASAPH, the Levite and psalmist whom David appointed as leading chorister in the temple. It is supposed that his office became hereditary in his family, or that he founded a school of poets and musicians called, after him, "the sons of Asaph."

AS'ARABAC'CA, a European herb. See ASARUM.

AS'ARUM, a small genus of herbs of the family *Aristolochiaceæ*, widely distributed in rich, shady woods throughout the northern hemisphere. They have odd chocolate or purplish, bell-shaped, three-lobed perianths containing 12 horned stamens. The flowers which are borne close to or upon the ground are hidden by the kidney-shaped or heart-shaped leaves. *A. canadense*, wild ginger, or Canada snake-root, is warmly aromatic. It is common in the eastern United States and is often cultivated in wild gardens as are also the following species: *A. virginicum, A. arifolium*, both common from Virginia southward; *A. caudatum*, a Pacific coast species, *A. lemmoni* and *A. hartwegii*, both of the Sierra Nevada of California at altitudes of 4,000 to 7,000 feet. *A. europæum* is also cultivated. It was formerly used as an emetic, a rôle now played by ipecacuanha. Its leaves are still made into snuffs and are deemed efficacious as counter-irritants.

ASBEN (Sahara). See AIR.

ASBESTIC, a by-product in the mining of asbestos suitable for wall plaster. It is a mixture of a second grade asbestos with serpentine which is crushed and mixed with lime and is susceptible of an excellent finish.

ASBESTOS (named from a Greek compound word signifying *inextinguishable, incombustible*), a fibrous fireproof mineral substance, one of the most remarkable found in nature. Several minerals are mined and sold as asbestos. The most important is chrysotile, the fibrous form of serpentine ($H_4Mg_3Si_2O_9$). Actinolite [$Ca(MgFe)_3(SiO_3)_4$] yields a variety usually known as hornblende asbestos. Another variety comes from the mineral known as anthophyllite ($MgFe)SiO_3$. The fibres formed by the chemical combination above given are perfectly smooth, and in this respect are different from all other known fibres. Paradoxically, it is at once fibrous and crystalline, elastic and brittle, heavy as a rock in its crude state, yet as light as thistledown when treated mechanically. Added to this, its fibres, soft, white and delicate, have, by their inherent quality of indestructibility, withstood the action of the elements since the world began. Asbestos is found widely distributed throughout the world, although the principal supply of crude asbestos suitable for the manufacture of fireproof cloths and curtains comes from near Black Lake and Thetford, Canada, about 75 miles from Quebec, where it has been mined since 1877. The Italian, Corsican and South European mineral has a fine, silk-like fibre, but is lacking in the essential characteristic of strength. The product obtained from South Carolina has a soft, woody, yellowish fibre, which quickly powders under pressure. The South African asbestos from Griqua Town is of a dark slate or black color, with exceptionally long, strong fibres, but owing to its stiff and horny texture it cannot be manufactured into a fine fabric, hence the superiority of the Canadian asbestos and its large consumption in the United States.

The asbestos usually occurs in veins, most commonly in serpentine rock which has resulted from the alteration of basic igneous rock, usually peridotites (q.v.). The chrysotile commonly occurs with the fibres across the vein, and is known as "cross fibre." The hornblende asbestos more often occurs along slip fractures with the fibre parallel to the plane of slipping, and is called "slip fibre."

The mining of asbestos differs radically from the mining of other minerals, since no shafts are sunk, but excavations are made in the open, somewhat after the manner of a stone quarry. Canadian asbestos, however, is found in narrow veins or seams about an inch and a quarter in thickness, and embedded in rock which is easily severed from it. The rock to which the mineral is attached shows on fresh fracture a serpentine mineral of a green shade containing finely divided particles of chromic and magnetic iron. The asbestos on cleavage presents a brilliant, dark-green surface by reflected light, but the fibres after they are detached are perfectly white. The act of separating the mineral from its matrix of rock is termed "hand cobbing," and after this process the mineral is shipped to various factories in the United States.

The process of manufacture begins by placing the asbestos mineral in a chaser mill, a machine comprising a rotating edge-wheel revolving at the end of a radical arm in a trough, which crushes the mineral, dividing the fibres without destroying them. The result is a snowy mass of mineral wool ready for winnowing, a method of removing the minute particles of rock still clinging to the fibres very much like the winnowing of grain; this is done by means of a blast of air, which separates and blows away the foreign matter, leaving the fibres in a refined state and in proper condition for the third stage of manufacture. This is termed air fibre raising, and as the name implies, the fibres are raised by a current of air produced by a blower of large dimensions through a vertical pipe inclined at a small angle. The object of this procedure will be obvious, when it is stated that the air blown across the fibres causes those of coarser texture to be deposited in a compartment near the bottom of the pipe. The medium fibres will be projected a little higher, and these will fall into a second compartment. The finer fibres will be blown to a higher point, and there collected, while the dust will be carried to the top and deposited. The fibres are in this way sorted into different lots according to their texture, and are ready to be made into articles for which they are best adapted. The fluffy stuff now goes to the carding room, just as though it were genuine wool sheared from a sheep or pure cotton fresh from the plant on which it grows, instead of a mineral substance that in its original state was mined like a lump of anthracite coal. A carding machine, similar to that employed in preparing wool, cotton or flax fibres before spinning, has been adopted by the manufacturers. The problem of mechanically combing these fibres was no small one, and the carding takes place in a machine having a large central rotating cylinder covered with card clothing, that is, strips of leather set with projecting wires termed teeth. Around the main cylinder there are a number of smaller cylinders, also provided with card clothing, which engages the teeth of the central cylinder rotating in the reverse direction. This machine straightens out the fibres and lays them parallel; after passing through the first breaker, they are fed into a second carding engine or breaker, which is set to a finer gauge than the preceding. A third and last carding process takes place in a machine called a finisher or condenser, when all the irregularities are eliminated, and the fibres are stripped from the final cylinder by means of a fly-comb and are converted into unspun threads, when they are delivered on a traveling apron or endless band, and are gathered into rows by reciprocating scrapers; they are then condensed, and the process is continued in the coiling cans. In spinning the yarn, the rovings are delivered to the spindles on a carriage, which then recedes, when the fibres are twisted, and returns when the spun asbestos yarn is wound on the spindles. The spinning frames do not draw the yarn, and no strain is placed on it until after it is twisted. This brings the manufacture of the fireproof material to a point where it is to be woven into cloth, packing, or other forms; for asbestos is used for divers other purposes than those appertaining to theatres.

While adulterated asbestos may be used in some of the mechanical arts, for theatrical hangings its purity should be 100 per cent; it then forms one of the safest barriers against the calamity of fire. As a matter of fact, much of

that which is termed commercially pure asbestos cloth contains from 5 to 20 per cent of combustible matter, but absolutely pure American-made cloth may be obtained. Not only is purity essential in asbestos cloth where used for protection against fire, but strength as well; and after asbestos is subjected to a high temperature, it has a tendency to powder, when, owing to its weight, it may break through, and its utility be impaired.

One of the leading manufacturers has made an improvement in weaving asbestos cloth for theatre curtains; it consists of two strands of asbestos spun around a strand of high-temperature-melting brass wire, so that the wire is completely embedded and concealed. These asbestos metallic strands form the warp, so that the threads run the long way of the cloth when finished. The weft, or filling-in cross threads, is made of plain, pure asbestos. Such a curtain will stand well under a severe high-temperature test without breaking. Not only theatre curtains, but set scenery of all kinds may be constructed of asbestos. Scenic artists find it more difficult to paint, but the finer textures may be utilized for this purpose; and although asbestos cloth does not take colors as satisfactorily as cheese cloth and burlap, yet its use should be provided for wherever audiences are to be assembled. Flooring and woodwork in general may easily be replaced by compressed asbestos fibre board, and it has been shown that the latter may be stained, polished and finished to as high a degree as wood. All the upholstery should be of pure asbestos cloth, and carpeting is also made to take the place of the combustible vegetable and animal fibres now used so extensively. One of the peculiar properties of asbestos carpeting is that the longer it is in service, the tougher it becomes.

Asbestos is utilized in the arts in many other forms than cloth; it may be worked into a pulp, and a fireproof paper is obtained. This paper is now used on roofs, between walls, flooring, etc. Fireproof rope three-eights inch in diameter for the suspension of curtains and other uses is made, having a tensile strength of 1,650 pounds per foot. High-grade asbestos plaster is fireproof, sound-proof, and hangs together with great tenacity when subjected to water.

In the United States asbestos is produced in five States—Arizona, California, Idaho, Georgia and Virginia. Of these Arizona and Georgia yield the largest output; Arizona of high grade fibre, and Georgia of fibre below the spinning grade. The asbestos of Arizona is chrysotile, and occurs in serpentine associated with limestone altered by intrusions of diabase. The strata are nearly horizontal, and are exposed along the walls of canyons throughout the State. The asbestos is worked out by tunneling into the canyon wall. Two grades are secured; one very fine and silky, of first-class spinning quality, and the other harsh, splintery and quite unsuited for textile purposes. Both qualities are found in the same mine. The Arizona asbestos has a much smaller percentage of iron than the Canadian staple, and is, therefore, better adapted for electrical insulations. In Georgia the asbestos mine near Sall Mountain has been for years the largest producer of asbestos in the United States. Only the surface portion of the deposit, which has been softened by weathering, is milled for fibre; the deeper lying rock is too hard.

California, Idaho, and Virginia produce no fibre of spinning grade, and their output is small. It is used chiefly for making fibre board and heat insulation, and as a filler for fireproofing cements, plaster and paints.

An undeveloped source, considered of great possibilities, is the area of asbestos-bearing rocks of Vermont, an extension of the noted deposits of the Quebec region of Canada. Enough work has been done in this section to demonstrate its potential value.

The marketed production of asbestos in the United States in 1916 was 1,479 short tons, valued at $448,214. In addition to this supply, 114,978 tons of raw fibre, valued at $3,069,617, were imported from Canada; 1,072 tons, valued at $223,228, from England; and 112 tons, valued at $10,625, from British South Africa. There was also imported a value of $135,064 in manufactured articles of asbestos, nearly all of which came from England. The asbestos mines of Quebec were extremely active in 1916. Their shipments amounted to 133,339 tons, valued at $5,182,905; of which the United States bought 86 per cent. The market, however, was so scantily supplied that prices rose from the average normal of $350 to $400 per ton for high grade fibre, to $1,250 per ton, and in some cases much higher; and even the low grade short fibre brought 100 per cent more than its usual price. (See MINERAL PRODUCTION OF THE UNITED STATES). Consult Cirkel, F., 'Chrysotile Asbestos' (Canada Department of Mines, Ottawa 1910).

ASBJÖRNSEN, as-byėrn'sĕn, **Peter Kristen,** a Norwegian folklorist and zoologist: b. Christiania, 15 Jan. 1812; d. there, 6 Jan. 1885. While pursuing botanical and zoological studies, and subsequently during various travels at government expense, he collected folk tales and legends, aided by his friend Jörgen Moe, with whom he published 'Norwegian Folk Tales' (1842–44); and 'Norwegian Gnome Stories and Folk Legends' (1845–48; 3d ed., 1870), pronounced by Jacob Grimm the best fairy tales in existence. Consult Braekstad, 'Fairy Tales from the Far North' (New York 1897); Dasent, G., 'Popular Tales from the Norse' and 'Tales from the Fjeld' (London).

ASBOTH, ŏsh'bōt, **Sandor (Alexander),** a Hungarian-American soldier: b. in 1811; d. in 1868. He came to America with Kossuth in 1851, and became a United States citizen, serving in the Civil War in the Federal army, attaining the rank of a brevet major-general. He was United States Minister to Argentina when he died from wounds received in 1862 and 1864.

ASBURY, ăz'bėr-ĭ, **Francis,** the first bishop of the Methodist Episcopal Church in the United States. He was born in Handsworth, Staffordshire, England, 20 Aug. 1745; d. Spottsylvania, Va., 31 March 1816. He joined the local ministry of the Methodists at the age of 16, the itinerant ministry six years later, and was sent by John Wesley as missionary to America at the age of 25. In 1772 he was appointed by Wesley general superintendent of the connection in America, the duties of which office he exercised through the entire period of the American Revolution. Until the termina-

tion of the war the Methodists of America had called themselves members of the Church of England, and their ministers laymen. They now considered the political changes of the country as separating them from that Church, and therefore established an organization for themselves. Francis Asbury was constituted the first bishop of the new Church (1784), which office he held till his death. During the 30 years of his episcopal labors he traveled annually from the Androscoggin to the Gulf of Mexico, and from the Atlantic to the Mississippi, ordained not less than 3,000 preachers, and preached about 17,000 sermons. Identified with the religious interests of this country through the two great struggles which have so greatly modified our political and social character, he became eminently American in his sympathies and character, and left the mark of his native enthusiasm and energy upon the ecclesiastical history of the United States. He wrote his journals, published in New York 1852. (3 vols.).

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ASBURY PARK, N. J., a city and popular summer resort in Monmouth County, on the Atlantic Ocean, six miles south of Long Branch and 40 miles south of New York city. It is on the line of the Pennsylvania and the Central Railroad of New Jersey. It adjoins Ocean Grove on the north, being separated from it by Wesley Lake. It was founded in 1869, and given a city charter in 1897. It has a property valuation of $3,000,000. Asbury Park and Ocean Grove were originally laid out by members of the Methodist Episcopal Church for camp meetings and other purposes. At Ocean Grove is one of the largest musical auditoriums in the country. The beach front, waterworks and sewage system are owned by the municipality. Pop. (1910) 10,150; in summer, 25,000 and upward.

ASCALON, or **ASHKELON,** a ruined town of Palestine, on the sea-coast, 40 miles west-southwest of Jerusalem. It was noted during the Crusades, Godfrey de Bouillon gaining here a great victory over the Egyptians in 1099, and it was captured by the English, under Richard I, in 1191. During the European War Ascalon was taken by the British 10 Nov. 1917. Its site is now a complete scene of desolation. See WAR, EUROPEAN; TURKISH CAMPAIGN.

ASCANIUS, a son of Æneas and Creusa, who accompanied his father to Italy. He supported Æneas in his war with the Latins, and succeeded him in the government of Latium. His descendants ruled over Alba for 420 years. He is known also as Iulus.

ASCARIS. See ROUND-WORMS; THREAD-WORMS.

ASCENDANTS, in law, the opposites to descendants in succession. When a father succeeds his son or an uncle his nephew, etc., the inheritance is said to ascend or to go to ascendants.

ASCENSION, an isolated volcanic island 700 miles northwest of Saint Helena, near the middle of the south Atlantic Ocean, about lat. 7° 55′ S.; long. 14° 21′ W.; area about 34 square miles. It belongs to Great Britain; is the sanatorium for the British West African squadron. There are about 200 inhabitants, mainly government employees and their families. Ascension is celebrated for its turtle, which weigh in many cases from 500 to 800 pounds. This island was discovered on Ascension Day, 1502, by the Portuguese, and hence its name; but it was never formally occupied by any nation till Great Britain took possession of it in 1815, after the transportation of Napoleon to Saint Helena. The island is connected by cable with Buenos Aires, England and the Cape.

ASCENSION, Right, a term employed in astronomy in allusion to the position of a star or other heavenly body. Such position is known when we know the right ascension and declination, these terms corresponding respectively to longitude and latitude as applied to the position of places on the globe. Right ascension is measured on the equinoctial or celestial equator, the first point of Aries being taken as the starting point; and the right ascension of any star is the distance measured eastward along the celestial equator from the first point of Aries to the point where an hour-circle, passing through the star, cuts the equator. The right ascension is easily found by means of the sidereal clock, which, when the first point of Aries passes the meridian, gives the time as 0 hours, 0 minutes, 0 seconds. By noting on the clock the time at which the body is on the meridian, we obtain the right ascension in time, which may be converted into degrees, minutes and seconds at the rate of one hour to 15°.

ASCENSION DAY, a religious festival of many churches in commemoration of the ascension of the Saviour. It is a movable feast, always falling on the Thursday but one before Whitsuntide. It was first observed about the 4th century.

ASCETICISM is the exercise of the faculties in moral and religious practices, the application of Saint Paul's comparison between an athlete's and a Christian's life (1 Cor. ix, 24, 27). It is negative, when the object of this exercise is to avoid evil, to curb vicious tendencies, moderate excessive passion, and deny the soul and body any indulgence which might become inordinate or unlawful, and whenever it implies active measures against such disorders as gluttony, sloth, anger, pride and lust, by abstinence, fasting, watching, self-restraint, modesty and habits conducive to continence. It is positive, when its object is the exercise or training in the virtues which perfect life, and the cultivation of the means most efficacious for this end, such as devout reading, especially of the scripture, meditation, prayer, examination of conscience, exertion and sacrifice for the good of others, zealous promotion of good enterprises; in a word, anything that can help one to do what is best, constantly, unhesitatingly and with facility. This is the aim of all true asceticism, whether based on the principles of natural or of positive and revealed law. This aim, as well as many of the means above enumerated, is found to some extent in Pagan and Jewish, as well as in Christian asceticism. The latter employs additional means of inculcating and developing the habit of virtue, such

as the religious life, divine worship, and in particular the sacramental system of the Church. Asceticism has some part in every rightly regulated life, even in one based on purely ethical principles; but in Christian life it is most systematic and far-reaching. The whole Christian economy depends on self-denial and the active pursuit of virtue according to fixed principles. Every sincere Christian is, accordingly, an ascetic; some are professedly so, men and women, whether in the conventual cloister or domestic circle, who strive to acquire by daily practice habits of virtue, and to advance in holiness. Naturally counsel and direction are needed in a matter so difficult, and it is for want of due attention to these that asceticism is often misunderstood, and is regarded by some as grotesque, a shield for certain excesses and extravagances, associated often with the external observances of communities like the Essenes, with the singularities of some hermits and anchorites, the frenzy of fanatics like the Flagellants, the exclusiveness of the Brahmins, the ablutions of the Mohammedan, the dream of men like those composing the Brook Farm Community. To appreciate asceticism in its normal exercise, one must study it in the examples of men and women noted for its exercise, or in the books whose guidance they followed, in works of the great ascetical and sermon writers, but chiefly in scripture, and in the life of Christ and of persons distinguished for holiness.

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ASCETICS, a name anciently given to those Christians who devoted themselves to severe exercises of piety, and strove to distinguish themselves from the world by abstinence from sensual enjoyments and by voluntary penances. Hence those writings which teach the spiritual exercises of piety are termed ascetic writings. Even before Christ, and in the time of the early Christian Church, there were similar ascetics among the Jews, such as the Essenes, also among the philosophers of Greece, and in particular among the Platonics. The expression is borrowed from the Greek word *askēsis* (exercise), used to signify the spare diet of the athletæ, who, to prepare themselves for their combats, abstained from many indulgences. Consult Frazer, J. G., 'The Golden Bough' (London 1900); Moore, G., 'Greek and Roman Ascetic Tendencies' (Boston 1912); Müller, F. Max (ed.), 'Sacred Books of the East' (London).

ASCH, äsh, manufacturing town in the extreme northwest corner of Bohemia. It contains a large Protestant and a newly erected Roman Catholic Church, a real-school, schools of design, weaving, etc. The inhabitants are mainly employed in cotton, wooden and silk manufacture, bleachfields and dye-works. Pop. (1910) 21,583.

ASCHAFFENBURG, ą-shä'fĕn-bûrg, a town of Bavaria, 26 miles east-southeast of Frankfort. The chief edifice is castle of Johannisberg, built in 1605–14. There is also the Pompeianum, an edifice built by King Louis of Bavaria, in imitation of the Casa del questore (commonly called the Castor and Pollux House) at Pompeii. The principal industries are the manufactures of colored paper, tobacco and liquors. There are also large breweries, and an extensive trade is done in wine and timber. Aschaffenburg long belonged to the archbishops of Mainz. Pop. 31,000.

ASCHAM, ăs'kăm, **Roger,** English scholar: b. Kirby Wiske, Yorkshire, 1515; d. London, 30 Dec. 1568. While still a child, he was taken into the family of Sir Anthony Wingfield and educated with the latter's children. He made rapid progress in English and classical studies, and was taught archery by Sir Anthony himself. The same generous patron sent him in 1530 to Saint John's College, Cambridge, where he read nearly all extant Latin literature, acquiring an elegant Latin style that proved most useful to him later, and developed an especial aptitude for Greek, which he taught to students younger than himself. Besides this, he paid some attention to mathematics, became an accomplished musician, and acquired remarkable skill in penmanship. He received his B.A. degree in February 1533–34, and became a fellow of his college. His reputation for Greek learning soon brought him many pupils, several of whom later rose to distinction, and students from other colleges attended his lectures. In five years, he afterward said, Sophocles and Euripides had become at his college as familiar as Plautus had been previously, and Demonsthenes was as much discussed as Cicero. The beauty of his handwriting and the purity of his Latin led to his being employed to write the official letters of the university. He took an active part in the controversy as to the correct mode of pronouncing Greek, opposing Sir John Cheke's system, but later adopting it. In 1543–44 he wrote his famous treatise on archery, 'Toxophilus,' and in person presented a copy of it to Henry VIII, who so approved of the work that he gave the author an annual pension of £10, which was renewed by Edward VI, whose Latin secretary Ascham became. In 1548 he was appointed tutor to Princess Elizabeth. He read with her all 'Cicero,' the greater part of 'Livy,' the 'New Testament' in Greek, 'Isocrates,' 'Sophocles,' and portions of 'Cyprian' and 'Melancthon.' Two years later he was nominated secretary to Sir Richard Morysin, ambassador to the Emperor Charles V. Their headquarters were at Augsburg, but Ascham made trips to Louvain, Halle, Innsbruck, Venice and Brussels, visiting famous teachers and scholars. He lived on excellent terms with Sir Richard, reading Greek with him five days in the week. The death of Edward caused the recall of the embassy in 1553, when Ascham became Latin secretary to Queen Mary. With the accession of Elizabeth, he was continued in his offices, and became in addition private tutor to the Queen, reading several hours a day with her in the learned languages. She bestowed on him the prebend of Wetwang in York Cathedral 5 Oct. 1559. His last years were filled with

anxiety and care due to domestic afflictions and pecuniary embarrassment. Between 1563 and his death he found relief in the composition of his best known work, 'The Scholemaster,' of which he completed two books. The first is a general discussion of education with arguments in favor of inducing a child to study by gentleness rather than by force. The second is an exposition of his famous method of teaching Latin, by means of "double translation," etc., a method which has been endorsed by all subsequent writers on the theory and methods of education. When Queen Elizabeth heard of Ascham's death, she is said to have exclaimed that she would rather have cast £10,000 into the sea than to have lost her tutor, Ascham. Scholars in England and on the Continent mourned for him, and expressed their grief in stately Latin verses. In English literature Ascham has a secure place on account of the strength and vigor of his English prose, highly Latinized though it was in construction and vocabulary. His style is without the tricks that Lyby introduced, and has an easy flow and straightforwardness.

Bibliography.— By far the best edition of Ascham's writings is 'The Whole Works of Roger Ascham . . . with a Life by Dr. J. A. Giles' (3 vols. in 4 parts, London 1864–65). This edition includes 295 Latin and English letters, many printed for the first time. 'Toxophilus' was first published in 1545; other editions appeared in 1571, 1589, 1788, 1821, 1865 (by J. A. Giles), 1868 (by E. Arber). 'The Scholemaster' was first issued 1570, and was followed by editions in 1571, 1572, 1573, 1579, 1583, 1589, 1711, 1743. Prof. J. E. B. Mayor published the best modern edition 1863, and E. Arber reprinted the first edition 1870. The best exposition of Ascham's educational system is in R. H. Quick's 'Essays on Educational Reformers' (1868). His English works, edited by Wright, were published in 1905.

ASCHBACH, äsh-bȧH, **Joseph,** German historian: b. Höchst, on the Main, 29 April 1801; d. Vienna, 25 April 1882. He studied at Heidelberg, at first taking up philosophy and theology and later history. In 1842 he was appointed professor of history at Bonn University. Nine years later he was called to fill the same position at the University of Vienna, where he remained until 1872. In his 'Geschichte der Westgoten' (Frankfurt 1827) he cleared up what had been until then a very obscure period in history. Among his other works are 'Geschichte der Omajjaden in Spanien' (1829); 'Geschichte Kaiser Sigismunds' (1834–45); 'Geschichte der Wiener Universität' (1865); 'Roswitha und Konrad Celtes' (1867).

ASCHERSLEBEN, ä'shĕrs-lā'bĕn, a town of Prussian Saxony, in the district of Magdeburg. It is walled and entered by five gates, and contains several churches, a synagogue, and a real-school of the first class. There are manufactures of woolen goods, paper, sugar, artificial manures, earthenware, etc. Among several interesting ruins in the vicinity is the old castle of Askanien, the cradle of the house of Anhalt. Pop. about 29,000.

ASCHERSON, ä'shĕr-zōn, **Paul Friedrich August,** German botanist: b. Berlin, 4 June 1834; d. 1913. In 1873 he was appointed professor of botany at the University of Berlin. A few months later he accompanied Rohlfs as botanist on an expedition to the Libyan Desert. The following winter he paid a visit alone to the Little Oasis. In 1884 he was appointed custodian of the Botanical Museum in Berlin. Among his works are 'Flora der Provinz Brandenburg' (Berlin 1864); 'Synopsis der mitteleuropäischen Flora' (2d ed., 1912). He also collaborated with Rohlfs on 'Reise von Tripolis nach der Oase Kufra.'

ASCIANS, ásh'yȧnz, people who live on the equator and consequently, at midday, twice a year, have the sun directly overhead.

ASCIDIAN, a marine animal, so called from *Ascidia,* a genus of *Tunicata.* Ascidians were once regarded as mollusks, and afterward as worms, but when their embryology and early stages were studied and it was found that they passed through a tadpole-like stage, in which the tail is supported by a notochord, and that in other respects they approached the vertebrates, they were placed with the vertebrates in the group *Chordata.* The simple ascidians attain to a large size, *A. callosa* being about two inches in diameter, quite round, and in shape and color much like a potato. The "sea-peach" (*Cynthia pyriformis*) is of the size and general shape of a peach, with its rich bloom and reddish tints. It is common at a depth of 10 to 50 fathoms on both sides of the north Atlantic. While other forms, as *Boltenia,* are stalked and fixed to the bottom, certain pelagic forms, as *Pyrosoma* and *Salpa* (q.v.), are free-swimming. The compound ascidians, such as *Amaræcium,* grow in white or reddish masses on sea-weeds, rocks, shells, etc., the individual animals being minute. The interesting form *Perophora* grows in bunches on piles and wharves on the southern coast of New England; it is perfectly transparent, so that the heart and circulation of the blood can readily be observed under the microscope. The heart is a straight tube, open at each end; after beating for a number of times, throwing the blood with its corpuscles in one direction, the beatings or contractions are regularly reversed, and the blood forced in an opposite direction. For a general account of the anatomy, development and metamorphoses of these animals, see TUNICATA.

ASCLE'PIADA'CEÆ, a family of more than 200 genera and 2,000 species of dicotyledonous herbs and shrubs, most of them with milky juice and many of them twining. The species are widely distributed in the temperate and tropical zones of both hemispheres and are especially abundant in Africa. They differ greatly in their characteristics and uses; some, like *Stephanotis floribunda,* are delightfully fragrant; others, like *Stapelia gigantea,* carrion flower, are repellantly odoriferous. Some species yield a fibre from their stems or their pods; some are used in medicine; others are planted for ornament. They are characterized by opposite or whorled, seldom scattered, entire leaves without stipules; umbels of symmetrical flowers, without calyx and with a five-parted corolla with often reflexed lobes; five stamens attached to the corolla and more or less united around the stigma; pollen grains more or less coherent; the ovary composed of two carpels; style short; stigma discoid; fruit a follicle or pod; seed flattened, with long silky hairs, which

buoy it up in the air for dispersal; cotyledons flat. In the United States Asclepias (q.v.), or milkweed, is the principal genus. Some of the more important genera are as follows: *Marsdenia, Stephanotis, Ceropegia, Stapelia, Hoya, Gonolobus, Periploca, Asclepias, Cynanchum, Vincetoxicum.*

ASCLEPIADES, ăs'klę-pī'ą-dēz, the name of several ancient Greek writers — poets, grammarians, etc.— of whom little is known, as well as of several physicians, the most celebrated of whom was Asclepiades, of Bithynia, who acquired considerable repute at Rome about the beginning of the 1st century B.C. Though it is doubtful if he ever learned either medicine or physiology, he obtained some measure of success by prescribing adherence to simple hygienic rules.

ASCLEPIAS, milkweed, silkweed, the type genus, of about 125 species, of the family *Asclepiadaceæ* (q.v.), the species, of which are mostly erect perennial weeds with thick, deep roots common in pastures and waste places. Some furnish a fibre strong enough for ropes, and the silky down attached to the seeds is often used for stuffing pillows, etc. The young shoots of some species are occasionally cooked like asparagus, which they are said to resemble somewhat. *A. tuberosa,* butterfly-weed, pleurisy root, common in dry banks and fields from New England to Florida, is very showy and seems to deserve a place in the flower-garden. Other well-known American species are *A. rubra, A. purpurascens, A. syriaca,* etc. The few species cultivated for ornament in America are mostly foreign. The genus is named in honor of the Greek god Asclepine, since some of the species are reputed carminatives, sudorifics and expectorants. Medicinally the milkweeds are of secondary value only. They are irritants, and cause nausea, vomiting and diarrhœa. They also cause diuresis and diaphoresis, but their exact action is in need of investigation.

ASCOLI, ăs'kō-lē, **Graziado Isaia,** Jewish-Italian philologist: b. Görz, Austria, 16 July 1829; d. 1907. At the age of 16 he had prepared a paper on south-European dialects which showed remarkable originality. In spite of the fact that he had had no collegiate training, he was, after the publication of his first work, 'Studi orientali linguistici' (1854), appointed professor of philology at the Academy of Milan. He was elected a member of the Institute of France, and of the Academies of Vienna, Budapest, Berlin and St. Petersburg, and in 1888 to the Italian Senate. His most notable work is 'Saggi ladini' (1873).

ASCOLI, or ASCOLI PICENO, ăs'kō-lē pēchā'nō (the ancient Asculum), an Italian town, 90 miles northeast of Rome. The town, one of the most ancient in Italy, is well built, and contains many handsome edifices and noble mansions, and the remains of an ancient theatre, temples, etc. It has manufactories of woolen cloths, leather, hats, cream of tartar, chinaware, sealing-wax, paper and glass. It has an active trade, and its port, at the mouth of the river Tronto, is much frequented by coasting vessels. Pop. about 30,000.

ASCOLI SATRIANO (anc. *Ascŭlum Apŭlum*), a town of southern Italy, 20 miles south of Foggia. Pop. about 10,000.

ASCOMYCETES, a large and important group of fungi, so called from their spores being contained in asci or sacs. This group includes mildews, rusts, smuts, the truffle, the morel and (according to Schwendener and other authorities) the lichens. Consult Engler and Prantl, 'Die natürlichen Pflanzenfamilien.' See FUNGI.

ASCONIUS (QUINTUS A. PEDIANUS), a Roman historian of the 1st century A.D., who wrote a life of Sallust, a reply to the critics of Virgil, and valuable commentaries to Cicero's orations, some of which are extant.

ASCOT, a celebrated English race-course in Berkshire, near the southwest extremity of the Windsor park and 29 miles southwest of London. The annual races, which take place in the second week in June, are attended by the fashionable and sporting public. From the accounts of the master of horse for the year 1712 it would appear that they were instituted, not in 1727, as is commonly supposed, but by Queen Anne on 6 Aug. 1711. Consult Cawthorne, 'Royal Ascot' (1902).

ASDOOD, or ASDOUD, a seaport of Palestine, on the Mediterranean, 35 miles west of Jerusalem. It was the Ashdod of scripture, one of the five confederate cities of the Philistines and one of the seats of the worship of Dagon (1 Sam. v, 5). It occupied a commanding position on the high road from Palestine to Egypt, and was never subdued by the Israelites. It sustained against Psammetichus a siege of 29 years; was destroyed by the Maccabees, and restored by the Romans. It is now an insignificant village, from which the sea is constantly receding.

ASELLI, ą-sĕl'lē, **Gasparo,** a famous Italian physician: b. Cremona about 1580; d. 1626. He was professor of anatomy and surgery at Padua, and in 1623 discovered the lacteal vessels, which he seems, however, never to have understood or described with complete accuracy. He left a treatise, 'De Lactibus' (1627).

ASELLUS, a fresh-water isopod crustacean, allied to the wood-lice (q.v.), common in ponds and standing water, under sticks and stones, and in open caves. These crustaceans differ from the common pill bugs of the land in having a pair of rather long forked two-jointed caudal appendages and antennæ of the second pair reaching to the telson. The body is broad and flat, with a broad shield-like telson, formed by the fusion of the last abdominal segments. There are six pairs of legs arising from the middle region of the body between the head and telson. The female carries her eggs under her breast, behind the head. Respiration is carried on by several pairs of broad, gill-like sacs appended to the broad, flat, abdominal legs. Blind individuals occur in caves, which are allied to the true blind *Asellus cæcidotæa.*

ASEN, ä'sĕn, in northern mythology, the most powerful of the gods. They included 12 gods and the same number of goddesses, among the most renowned of whom were Odin, Thor, Baldur, Freyr, Frigga, Freyja, Idunna, Eira and Saga. Their dwelling-place was Asgard. Though this worship was native only to the tribes of Scandinavia, its influence extended throughout ancient Germany, and may still be traced in many German proper names. Thus

the German names of the days of the week, which through the Saxons became incorporated into the English language, are derived from this mythology (see ASGARD). Asen was also the name of several mediæval czars of Bulgaria.

ASENATH, the daughter of Potipherah, priest of On, and the wife of Joseph (Gen. xli, 45, 50).

ASEPSIS. See ANTISEPTICS.

ASEXUAL GENERATION. See PARTHENOGENESIS.

ASGARD, ăs'gärd, the home of the Æsir, or Asen, and the Olympus of northern mythology. The city of Asgard is fabled to have been built in the middle of Ida's plain, the very centre of the universe. Here the Æsir erected a court for themselves with seats for 12 and one high seat for Odin, the All-father, and also a lofty abode for the goddesses, called Vingolf. They worked diligently, played at games, were rich in gold and all precious things, and happy, till three maidens from Jotunheim, the giants' world, crossed Ida's plain and entered Asaheim, when corruption spread among its inmates. Asgard had many mansions, the largest and noblest of which was Gladsheim; while another, not so spacious, but the fairest of all and brighter than the sun, was called Gimli. See SCANDINAVIAN MYTHOLOGY.

ASGILL, ăs'gĭl, **John,** English writer: b. Hanley Castle 1659; d. 1738. He was bred to the law, and gained considerable reputation, not only by skill in his profession, but from his pamphlet declaring that man might pass into eternal life without dying. In 1703 he took his seat in the Irish Parliament, but was dismissed after four days on account of his so-called blasphemous pamphlet. In 1705 he sat in the English Parliament for Bramber; but in 1707 he was expelled, nominally on account of his unlucky pamphlet, but really perhaps because of his debts. The remainder of his life he spent in the Fleet and King's Bench prisons, in one of which he died. He wrote a number of pamphlets against the Pretender in behalf of the Hanoverian succession.

ASH (*Fraxinus*), a genus of about 50 species of hardy, ornamental trees of the family *Oleaceæ,* natives mainly of North America, Europe and western Asia. The species are prized for street and park planting for which their usually tall pyramidal or broad-topped habit and light green foliage, which turns yellow or purple in autumn but which falls early, make them specially attractive. From the elegance of their forms several species, notably the first mentioned below, have been called the Venus of the forest; the oak being the Hercules. The leaves are rather large, opposite, pinnate and deciduous; the flowers greenish or whitish in panicles, appearing either before, with or after the leaves; the fruits are rather small samaras. Since grass and other plants do not grow well in the immediate vicinity of the ash it is not a good lawn species. The common ash (*Fraxinus excelsior*), a native of Europe and western Asia, found in its perfection upon loamy soil, often attains a height of 120 or even 150 feet. It also thrives in exposed and elevated situations better than many other trees. Its naked flowers appear long before the leaves, which drop early in the autumn, but during the summer are very ornamental. Its leaflets are sessile and toothed. Its tough, hard, white wood makes excellent fuel and is highly valued for turning (for carriage wheels especially) when the tree has grown rapidly, since the toughness is then very great. It is then particularly valuable for carriage shafts, ladders, and handles of agricultural tools, such as rakes, pitchforks and hoes, where pliability, toughness and lightness are essential. For such uses its only important rival in America is the hickory. When gnarled, as it occasionally is, it is prepared like "curly" maple for cabinet work and furniture, especially fine-grained specimens being used as veneer. The bark is used to some extent in leather tanning. A large number of cultivated varieties have been produced, among which the most remarkable are: *monophylla,* with simple instead of compound leaves or with only one or two small leaflets at the base of the main leaf-blade; *albo-marginata,* the leaflets of which are bordered with white; *albo-variegata,* with mottled white and green leaflets; *aurea,* yellow-branched; *aurea-pendula,* drooping yellow branches; *pendula,* one of the best weeping trees; *crispa,* with curled and twisted very dark green leaves. The American or white ash (*F. americana*), a very variable species common from New Brunswick to Florida and westward to Minnesota and Texas, attains about the same size as the preceding species, but has lighter bark and leaves. The leaflets have short stalks and are entire. In rich, moist, dense woods the trunks often attain a height of 40 feet without a branch, thus furnishing valuable timber, which is used for the same purposes as that of the preceding species. There are many varieties which more or less resemble those of the common ash. The black or water ash (*F. nigra*), common in swamps and upon stream banks from Nova Scotia to Minnesota and southward to Missouri and Virginia, often attains a height of 80 feet. Its wood is softer than that of the preceding, but, being tough and easily separable longitudinally into layers, is largely used for veneer, baskets, barrel staves and hoops. The red ash (*F. pennsylvanica*) is common in low ground from maritime Canada to Florida, being especially abundant in the swamps of Pennsylvania, Maryland and Virginia. It is rare west of Ohio, though found as far west as Dakota and Minnesota. It resembles the American ash in uses and in general appearance. The interior of the outer bark of the branches is cinnamon color or red when fresh. The blue ash (*F. quadrangulata*), common in rich, dry or moist woods from Michigan and Minnesota to Tennessee and Arkansas, and especially abundant in Ohio and Kentucky, attains a height of 80 to 120 feet. Its branches are more or less four-angled, hence the specific name. The inner bark yields a blue color when steeped in water, hence the common name. The green ash (*F. lanceolata*), a species very widely distributed over eastern Canada and the United States, is so called from the brilliant green of its young shoots. It is extensively planted to form wind-breaks in Minnesota and the Dakotas on account of its extreme hardiness and because it is easily propagated by seeds and also because it grows very rapidly. It is less valued for its wood than the white ash, but is useful for fuel. The Carolina or water ash

(*F. caroliniana*) seldom exceeds 40 feet in height, but is noted for its very large leaflets. It is distributed from Virginia to Florida and westward to Arkansas and Texas, being most plentiful in swamps, along watercourses and in damp, rich woods. Its wood is used like that of the white ash. *F. cuspidata,* a native of the southwestern United States and northern Mexico, is a shrub or small tree which seldom exceeds 20 feet in height, and on account of its conspicuous panicles of fragrant flowers is often planted in temperate climates for ornamental purposes. *F. velutina,* another species of the same region, seldom attains a height of 50 feet, and not being hardy is confined to southern planting. The manna or flowering ash (*F. Ornus*), a native of southern Europe and western Asia, is a small tree 25 feet tall which resembles the common ash. It furnishes manna (q.v.). It is a native of Greece. Many other species are of botanical, economic or ornamental interest, but probably none of as much importance as the species mentioned. The mountain ash (q.v.), a member of the family *Malaceæ* obtains its name from its ash-like leaves. Consult Nicholson, 'Dictionary of Gardening' (1888); Bailey, 'Standard Cyclopedia of Horticulture' (1914).

ASH-LEAVED MAPLE. See Box Elder.

ASH-WEDNESDAY, the first day of Lent in the Western Church, so named from the ceremonial use of ashes as a symbol of penitence in the service for the day. The ceremony is of great antiquity, being confined at first to those performing a public penance. Later it was extended to the entire congregation. In 1191 its universal use was first sanctioned by Pope Celestin III. The present custom in the Roman Catholic Church is to take the ashes, made by burning the palms or their substitutes used in the ceremonial of the previous Palm Sunday, and after a prayer the priest, dipping his thumb in the ashes, marks those present, as they kneel, with the sign of the cross on the forhead, or, in the case of clerics, on the place of tonsure, with the words: Memento, homo, quia pulvus es et in pulverem reverteris (Remember, man, that thou art dust and into dust thou shalt return). Of the Reformed churches the Anglican Church and the Protestant Episcopal Church in the United States alone have a special service for this day. In the former a series of denunciations against sinners — the commination — and penitential prayers are appointed to be read; but in the American only the penitential prayers. Consult Duchesne, L., 'Christian Worship,' translated by M. L. McClure (London 1904) and Wetzer and Welte 'Kirchenlexikon.'

ASHANTI, or **ASHANTEE,** ą-shän'tē, a former negro kingdom of western Africa, since 27 Aug. 1896, a British colony of the Gold Coast administered by its governor, under a separate constitution, and definitely annexed, 26 Sept. 1901. Its boundaries defined 22 Oct. 1906, enclose an area of 20,000 square miles. It is in general hilly and is largely covered with forests. It is well watered and extremely fertile, but the climate is unhealthful. Among the trees are the baobab, palms and cotton trees. The crops are chiefly rice, corn, sugar-cane and yams, the last forming the staple vegetable food of the natives. The domestic animals are cattle, horses of small size, goats, and a species of hairy sheep. The larger wild animals are the elephant, rhinoceros, buffalo, lion, hippopotamus, etc. Birds are numerous and crocodiles and other reptiles abound. Gold is obtained in the form of dust or in nuggets; in 1914 the output was 113,286 ounces valued at $2,406,350. Under British rule, agriculture has extended, cocoa and rubber plantations have been established, and the valuable forest trees exploited. Imports into Ashanti in 1914 amounted to $4,427,645; exports, $5,851,350, besides gold, comprising cocoa, $1,750,000; kola, $900,000; rubber, $100,000. The Ashantis long made themselves known as warlike and ferocious, with a love of shedding human blood amounting to a passion. Human teeth and jawbones were worn as personal ornaments, and human sacrifices used to be frequent. On the death of a king or chief enormous numbers of victims were slaughtered with circumstances of revolting cruelty, and there were regularly recurring periods, at intervals of 18 or 24 days, called the great and little *adai,* when human sacrifices were made. Notwithstanding this there exist, among them certain of the arts of civilization. They excel in the manufacture of cotton cloths and in the fabrication of articles in gold; they make good earthenware, tan leather, and make sword-blades of superior workmanship. The native government was a monarchy. The chief town is Coomassie or Kumasi; pop. 20,000. The British first came in contact with the Ashantis in 1807, when a treaty was concluded by the governor of Cape Coast with the king of Ashanti, acknowledging the sovereignty of the latter by right of conquest over the coast, including Cape Coast Castle. In 1823 war was proclaimed by the Ashantis against the British, and they succeeded in the following year in defeating a small body of troops led by the governor, who perished with almost all his officers; but in 1826 the Ashantis were completely defeated near Accra. At the close of another war, in 1831, the river Prah was fixed as the boundary between the Ashanti kingdom and the states protected by Great Britain, but the Ashantis soon began to interfere beyond the boundary. Early in 1873 the Ashantis again invaded the territory protected by Great Britain, and General Wolseley (subsequently Viscount Wolseley) was sent against them. The Ashanti general Amanquantia had concentrated his troops, 20,000 strong, at Amoaful, 20 miles from Coomassie. The British general led to the attack 1,481 English and 708 native troops, whom he formed into a square. The battle began on 31 January, on which day Amoaful was taken. On the 4th Coomassie was entered. The loss of the British in killed and wounded was 300, and a large number ultimately succumbed to the climate. As the King refused to enter Coomassie to sign a treaty, the British set fire to the town and began their return march on the 6th. The treaty signed soon after stipulated that the King of Ashanti should renounce his claims to the protectorate over the allies of Great Britain; that free trade and open communication should be established with the coast, and that the King should pay an indemnity of 50,000 ounces of gold. The last condition was not faithfully observed, but the

result of the war was greatly to weaken the power of the Ashantis. The conduct of King Prempeh, a successor of King Koffee, led to the dispatch of another British expedition, which in 1896 entered Coomassie without resistance, and received the submission of the King, who was taken and sent into banishment. A British resident was stationed in the country, which became a British protectorate, subordinate to the governor of the Gold Coast. In June 1898 an agreement was arrived at between Great Britain and France with regard to the boundaries between their respective territories here. In 1900 the Ashantis rose in rebellion and besieged the governor and 700 troops in Coomassie. The governor and part of the garrison fought their way out 23 June, and after four months' siege an expedition reoccupied the capital 15 July. The definite annexation to the British empire followed 26 Sept. 1901. Pop. 300,000.

ASHBOURNE, Edward Gibson, 1ST BARON OF, Irish jurist and politician: b. 4 Dec. 1837; d. 1913. After graduating from Trinity College he began practising law, becoming a Queen's Counsel in 1872. In 1875 he was sent to Parliament, where he served his constituency until 1885. From 1877 until 1880 he was attorney-general for Ireland and in 1885 he was made Lord Chancellor of Ireland. Here he remained, having a seat in the Cabinet, until 1892. In 1885 he was awarded his title.

ASHBURN, Ga., city and county-seat of Turner County, 85 miles south of Macon, on the Georgia Southern and Florida, and the Hawkinsville and Florida Southern railways. It has manufactures of yellow pine, a cotton-seed-oil mill, a fertilizer factory, feed mills and naval stores. It has also three banks, an assessed property valuation of $1,100,000, county and city buildings, schools for white and colored children and churches of four denominations. The waterworks, lighting plant and sewer system are owned by the municipality, the government of which is vested in a mayor and five councilmen. Pop. 2,500.

ASH'BURNER, Charles Albert, American geologist: b. Philadelphia, 9 Feb. 1854; d. Pittsburgh, 24 Dec. 1889. He was graduated head of his class at the University of Pennsylvania, and was appointed assistant State geologist in 1875. He originated a method of surveying and representing the geology of the anthracite coal fields which received the approbation of mining engineers throughout the world. He was also an accepted authority on the natural-gas fields. In 1886 he entered private practice as an expert and became closely associated with the Westinghouse interests. He prepared over 20 of the Pennsylvania State geological survey reports, and contributed to scientific and technical journals.

ASHBURNHAM, John, English Royalist: b. 1603; d. 15 Jan. 1671. Under Buckingham's patronage, he began his court career very early. In 1627 he was sent to Paris to make overtures for peace, and in 1628 he prepared to join the expedition to Rochelle, interrupted by the Duke's assassination. The same year he was made Groom of the Bedchamber and elected member of Parliament for Hastings. He also represented this borough in the Long Parliament of 1640. In this capacity he rendered services by reporting proceedings to the King. He made a considerable fortune and recovered the Ashburnham estates alienated by his father. He became one of the King's chief advisers and had his full confidence. In the Civil War he was made treasurer of the Royal army; in 1664 he was a commissioner at Uxbridge and one of the four appointed to lay the King's proposals before Parliament. He accompanied Charles in his flight from Oxford to the Scots and subsequently escaped abroad to Paris and then to Rouen, after which he was sent to The Hague to obtain aid from the Prince of Orange. After the seizure of Charles by the army, Ashburnham joined him at Hampton Court in 1647. When Charles escaped he took Ashburnham's advice and went to the Isle of Wight where he fell into the hands of Hammond. He left Charles, waited on the mainland for his escape, and was later captured and imprisoned at Windsor. During the Civil War, he was exchanged for Sir W. Masham. In November he was allowed to compound for his estates. After the King's death, he remained in England, an object of suspicion to all parties, until, at the Restoration, he regained his place as Knight of the Bedchamber and was compensated for his losses. He represented Sussex in Parliament from 1661–67 when he was expelled for taking a bribe from the French wine merchants. Consult 'Narrative' published by Lord Ashburnham (3d Earl) in 1830.

ASHBURTON, Alexander Baring, LORD, English statesman and financier: b. London, 27 Oct. 1774; d. 13 May 1848. He was the second son of Sir Francis Baring, and the affairs of the famous mercantile house established by his father kept him employed in Canada and the United States for many years. In 1810 he became the head of the house of Baring Brothers. He sat in Parliament for different constituencies from 1806 to 1835. He was created Baron Ashburton in 1835. He was appointed special ambassador to the United States in 1842 to settle the northwestern boundary question and other matters in dispute between England and America. A street in Boston, known as Ashburton Place, was named in his honor.

ASHBURTON RIVER, a stream in western Australia flowing 400 miles and emptying into the Indian Ocean, lat. 22° S.; long. 115° W.

ASHBURTON TREATY, a treaty concluded at Washington in August 1842 by Alexander Baring, Lord Ashburton, and the President of the United States. It defined the boundaries between the United States and Canada.

ASHBY-STERRY, Joseph, English journalist: b. London. Studied painting, then became illustrator for *Punch* and other papers. Later he took to writing and abandoned illustrating. Among his works are 'Nutshell Novels' (1890); 'Lazy Minstrel' (1892); 'Naughty Girl; a Story of 1893' (1893); 'A Tale of the Thames in Verse' (1896); 'The Bystanders; or, Leaves for the Lazy' (1900); 'Sketches in Song' (1903); 'River Poems' (1909).

ASHBY-DE-LA-ZOUCHE, ăsh'bĭ-dĕ-la-zooch', market town in Leicestershire, England, on the borders of Derbyshire, 17 miles north-

west of Leicester. It has wide, well-paved streets, and its parish church of Saint Helen is a handsome building with fine stained-glass windows, carvings and monuments. The Ivanhoe baths attract visitors, the waters being beneficial for some ailments. The ruins of Ashby Castle, well known to readers of 'Ivanhoe,' which received Mary Queen of Scots as a prisoner, are still visible. Pop. (1911) 4,927.

ASHDOD. See Asdood.

ASHE, ăsh, **John,** American soldier: b. in North Carolina 1720; d. 24 Oct. 1781. He was a member of the 1st Provincial Congress and served in the American Revolution as a brigadier-general of North Carolina troops. Asheville, N. C., was called in his honor.

ASH'ER, the name of the eighth son of Jacob. He founded the tribe called after him, which occupied a fertile territory in Palestine along the coast between Carmel and Lebanon.

ASHER, Ben Yehiel, eminent Talmudist: b. west Germany about 1250; d. Toledo, Spain, 1328. He was of a very learned family. To escape persecution, he fled to Spain, where he became rabbi at Toledo. Although he had had considerable means in Germany, he lost much of it and was forced to live in poverty in Toledo. In his religious attitude he resembled his teacher, Meïr of Rothenburg, representing the school which was opposed to lenient decisions in legal matters, and secular knowledge. He possessed a vast Talmudic learning and was distinguished for his terseness in summing up long Talmudic disctussions. His attitude toward secular knowledge made his influence on the Spanish Jews a narrowing one, which turned them from scientific research to the study of the Talmud. He was the first of the German rabbis who displayed a genius for systematization. His works consist of a commentary on 'Zera im,' a 'Compendium of the Talmud' and various other glosses and commentaries. His son Jacob was the author of the four 'Turim,' a very profound and popular codification of the rabbinical law. It was the standard work on law until Joseph Quaro directly based on it his Code of Jewish Law, the 'Shulan Arukh.' Consult Weiss, 'Dor Dor we Dorshaw' (Vol. V, 61–70); Grätz, 'Geschichte der Juden' (3d ed., VII, 233 et seq.).

ASHEVILLE, ăsh'vĭl, N. C., city and county-seat of Buncombe County, on the Southern Railroad, near the French Broad River, 275 miles west of Raleigh. It is in a tobacco-growing and market garden region, famous for its fruit, especially apples; and it is widely famed as a winter and summer resort. Its principal manufactures are of cotton goods, shoes, ice, tobacco and flour. The United States census of 1914 recorded 46 manufacturing establishments of factory grade, employing 1,135 persons, of whom 1,006 were wage earners, receiving annually $394,000 in wages. The capital invested amounted to $2,956,000, and the year's production was valued at $3,202,000; of this $1,027,000 was added by manufacture. The city is 2,350 feet above the level of the sea and is surrounded by impressive mountain scenery. It has the Asheville College for Young Women, Bingham Military School, Asheville Farm School for Boys, Normal College and Collegiate Institute for Young Women, Home Industrial School for Girls, Industrial School for Colored Youth, large central auditorium seating 2,000 and free to conventions, sanitarium, weather bureau, national banks, fine parks, beautiful drives, hotels, boarding-houses, etc., and among notable public buildings, post-office, government building, county courthouse, city hall and free public library. It has electric light and gas plants, a modern system of sewers, a water supply by 17 miles of pipe line from trout streams on the water shed of Mount Mitchell, and an electric street car system with a trolley road to Sunset Mountains. In the suburbs are: the magnificent estate of Biltmore, established by George Vanderbilt of New York city; one of the finest botanical gardens in the world; Pisgah Forest, a hunting preserve of 84,000 acres; Riverside parks; and Mount Beaumont, 2,800 feet high. Asheville was settled in 1792 and was named in honor of Samuel Ashe (1725–1813) jurist, and John Ashe (1720–81) soldier. It received a charter of incorporation in 1835. In 1905 the city boundaries were extended. The commission form of government has been adopted. Pop. (1916) 20,000.

ASHFORD, Bailey Kelly, American surgeon: b. Washington, D. C., 18 Sept. 1873. Graduating from the Georgetown University Medical School in 1896, and from the Army Medical School two years later, he accompanied the army to Porto Rico in 1898. Here he made a special study of anæmia and the hookworm disease and organized the government's campaign against the plague, resulting in a lowering of the death rate from anæmia by 90 per cent. From 1904 to 1906 he served as a member of the Porto Rico Anæmia Commission, which he himself had organized. He was also chairman of the consulting staff of the Presbyterian Hospital in San Juan. He has written 'Anæmia in Porto Rico' (1904); 'Uncinariasis in Porto Rico: a Medical and Economic Problem' (1911).

ASHFORD, England, market town in Kent, pleasantly situated on the river Stour, 56 miles from London. There are corn and cattle markets, and the Southeastern Railway Company have their principal locomotive and carriage establishments here. Pop. (1914) 13,668.

ASHI, Rabbi, Jewish scholar of ancient Babylon: b. 352 A.D.; d. 427 A.D. While still a young man he was the head of the academy at Sura. He is principally known because of his compilation, the 'Gemara,' composed of the discussions of the Jewish rabbis on the Mishnah and which constitutes an important part of the Talmud.

ASHHURST, John, American surgeon: b. 1839; d. 1900. He graduated at the University of Pennsylvania in 1857; served as an army surgeon in the Civil War; became surgeon of several Philadelphia hospitals after his return; and was made president of the College of Physicians in Philadelphia in 1898. He held surgical chairs in the University of Pennsylvania; was a member of the principal medical and surgical associations of the country; and besides many individual publications edited the 'International Encyclopædia of Surgery' (1881–86); and 'Lippincott's New Medical Dictionary.' He was the author of 'Injuries

of the Spine' (1867); and 'Principles and Practice of Surgery' (1871).

ASHIKAGA, ä'shē-kä'gä, Japan, town 17 miles by rail from Tokio. From the 9th to the 17th century it was of much importance as a seat of learning. It is now noted for its trade in silk and cotton. Pop. about 24,000.

ASHIO, Honshiu, Japan, town, famous because of two copper mines in the vicinity, the largest in the country, whose output in 1910 exceeded 300,000 tons. Silver is also mined in the district. Extensive smelting works make the town quite an industrial centre. Pop. about 22,000.

ASHKELON. See ASCALON.

ASHLAND, Ill., town in Cass County, on the Chicago and Alton, and the Baltimore and Ohio railroads, 20 miles west by north of Springfield. It contains a high school, public primary school, city hall, four churches, and two banks with combined resources amounting to $800,000. It is located in a thriving agricultural region and has grain elevators and a brick and tile factory. The municipal revenue amounts annually to about $4,000. The government is vested in a president and board of trustees. Pop. 1,200.

ASHLAND, Ky., city of Boyd County, on the Ohio River and on the Chesapeake & Ohio, Norfolk & Western and other railroads, 130 miles northeast of Frankfort. It was settled in 1854 and chartered as a city in 1870. Its manufactures include cut and wire nails, steel billets, sheet steel, leather furniture, etc., and it is a shipping point for iron ore and coal. Among the city's attractive features are Central Park and the corporation-administered Clyffeside Recreation Park. Pop. 8,688.

ASHLAND, Ohio, town and county-seat of Ashland County, on the Erie Railroad, 65 miles southwest of Cleveland. It has important manufactures of rubber goods, pumps, tools, etc., municipal waterworks, public library and carries on a large trade in hay, stock and poultry foods. Pop. (1910) 6,795.

ASHLAND, Ore., city and county-seat of Jackson County, situated in the extreme southern part of the State, on the Southern Pacific Railroad, 341 miles south from Portland and 431 miles northerly from San Francisco. Ashland is the seat of the Southern Oregon State Normal School, and has three public school buildings and eight church buildings. The city has an excellent municipal organization and police regulation. Ashland owns its own water system. There is an extensive electric-light and power plant, flour-mill, ice plant, sash and door factories, box factory, quartz-mill, foundry and machine shops, and three newspapers. The Southern Oregon Chautauqua Association is located here. There are valuable gold mines in the mountains near by, some of them almost within the city limits. Copper, iron and coal have also been found as well as other valuable minerals, such as cinnabar, kaolin, marble, sandstone, etc. In the vicinity are many mineral springs, whose waters contain medicinal properties. Pop. 6,000.

ASHLAND, Pa., borough in Schuylkill County, in the valley of the Mahanoy, and on the Lehigh Valley and other railroads, 12 miles northwest of Pottsville. It is in the centre of the great anthracite coal field, has extensive mining industries, large machine shops, foundries and factories, municipal waterworks, and contains the State Miners' Hospital, a national bank, public hall and several churches. Settled in 1850 and named after Henry Clay's home at Lexington, Ky., Ashland was incorporated in 1857. Pop. 6,855.

ASHLAND, Va., town of Hanover County, situated on the Richmond, F. & P. Railroad, 17 miles north of Richmond. It is the seat of Randolph-Macon College, one of the oldest Methodist Episcopal Colleges in the United States, founded in Mecklenburg County in 1832, and removed to Ashland in 1866. Ashland was the scene of several battles during the Civil War. Within short distances of the town are the birthplaces of Henry Clay and Patrick Henry. Pop. 1,324.

ASHLAND, Wis., city and county-seat of Ashland County, on Chequamegon Bay, Lake Superior, and several railroads; 80 miles east of Duluth. It has one of the finest harbors on the lake, and beside its general lake traffic is the principal shipping port for the hematite ore of the great Gogebic Iron Range. To accommodate its iron interests it has a number of enormous ore docks. Other important interests are lumber and brown stone. It has very large charcoal blast furnaces, used for the manufacture of pig iron, and since 1885, when the real development of the Gogebic iron mines began, the city has grown rapidly. Near by is the scenic and historic group of Apostles' Islands. The city has several industries of the manufacturing class, including flouring mills, pulp mills, creameries, etc. The United States census of 1914 reported 37 manufacturing establishments of factory grade, employing 924 persons, of whom 797 were wage earners, receiving $510,000 annually in wages. The capital invested was $3,463,000, and the value of the year's output was $1,827,000; of this, $750,000 was added by manufacture. The institutions include the North Wisconsin Academy, Sisters' Hospital (Roman Catholic) and Rhinehart Hospital. Ashland was settled in 1854, incorporated in 1863, received a city charter in 1887, and since 1913 is administered by a commission form of government. Pop. 14,500.

ASHLEY, Lord. See SHAFTESBURY.

ASHLEY, William H., fur trader, soldier and congressman: b. Powhatan County, Va., about 1788; d. near Booneville, Mo., 26 March 1838. After a public school education he removed to Missouri (then upper Louisiana) in 1808. In the territorial militia he rose to the rank of brigadier-general. Embarking in the fur trade, he organized a company of 300 members which in 1822 ranged as far as the Rocky Mountains and entered into trading relations with the Indians of the region. He amassed considerable wealth; was appointed lieutenant-governor of Illinois in 1820, and was elected as representative for Missouri to the Congress from 1831–37. Consult Houck, 'History of Missouri,' and Chittenden, 'Fur Trade.'

ASHLEY, William James, Anglo-American economist: b. London, England, 25 Feb. 1860. He was graduated from Balliol College, Oxford, in 1881; was Fellow of Lincoln Col-

lege, Oxford; lecturer in history in Lincoln and Corpus Christi, 1885–88, and professor of political economy and constitutional history at the University of Toronto, Canada, 1888–92. He has been professor of economic history at Harvard University, 1892–1901, and since 1901 professor of commerce and public finance in the University of Birmingham. He has written 'Introduction to English Economic History and Theory' (1888–93); 'Surveys, Historic and Economic' (1900); 'Tariff Problem' (1903); 'Progress of the German Working Classes' (1904); 'The Rise in Prices' (1912); 'Gold and Prices' (1912); 'Economic Organization of England' (1914). He has edited some important works bearing on economics.

ASHLEY, Pa., town in Luzerne County, near Wilkes-Barre, on the Central of New Jersey and the Wilkes-Barre and Hazelton railroads. It is an active coal mining centre and the site of important railroad repair shops. Pop. 5,601.

ASHMEAD-BARTLETT, Sir **Ellis,** English politician: b. Brooklyn, N. Y., 1849; d. London, England, 18 Jan. 1902. He was educated at Christ Church College, Oxford, and admitted to the bar in 1877. He was examiner of the Education Department, 1874–80; Conservative member of Parliament for the borough of Eye, 1880–85, and from Sheffield, 1885–1902; Civil Lord of the Admiralty, 1885, 1886–92; and was knighted in 1892. His popularity with political audiences in the early 80's was second only to that of Lord Randolph Churchill, but he lost much of this influence in later years owing to his association with the Turks and Swazis—a connection which subjected him to considerable ridicule in the House of Commons and the press. His chief literary production was 'The Battlefields of Thessaly' (1897), a record of his experiences in the last war between Greece and Turkey.

ASHMEAD-BARTLETT, Ellis, English war correspondent: b. 1881, son of preceding. He accompanied his father during the Græco-Turkish War and was taken prisoner by the Greeks. He has served as war correspondent in the Russo-Japanese War, the Moroccan campaign in 1907, accompanied the Spanish army in the expedition against the Riffs in Morocco in 1909, and the Italian army in the Tripolitan campaign; was through the first and second Balkan wars (1912–13), and correspondent in the European War, 1914–16. He is the author of 'Port Arthur, the Siege and Capture'; 'The Passing of the Shereefian Empire.'

ASHMOLE, Elias, English antiquary: b. Lichfield 1617; d. 1692. He practised as a chancery solicitor till the breaking out of the Civil War, when he retired to Oxford and entered himself at Brasenose College, and engaged in the study of natural philosophy, mathematics and astronomy. At the Restoration he received the post of Windsor herald and other appointments both honorable and lucrative. In 1672 appeared his 'History of the Order of the Garter.' Other works of his are 'The Antiquities of Berkshire' (1719); and his 'Diary' (1717). He presented to the University of Oxford his collection of rarities to which he afterward added his books and manuscripts, thereby commencing the Ashmolean Museum.

ASHMOLEAN MUSEUM, Oxford, the first public museum of antiquities and curiosities in England, was founded by Elias Ashmole (q.v.) in 1679 and presented to Oxford University. The building was erected by Sir Christopher Wren in 1682.

ASHMUN, George, American lawyer: b. Blandford, Mass., 1804; d. 1870. He served for several years in the legislature of his native State and was prominent in Congress in 1845–50. He presided over the Chicago Convention which in 1860 nominated Lincoln for the presidency.

ASHMUN, Jehudi, American missionary: b. Champlain, N. Y., April 1794; d. Boston, Mass., 25 Aug. 1828. He prepared for the Congregational ministry and became professor in Bangor Theological Seminary. Later he joined the Protestant Episcopal Church and edited one of its periodicals *The Theological Repertory*. He discovered his true vocation when he became an agent of the American Colonization Society and took charge of a reinforcement for the colony of Liberia in 1822. He found the colony utterly disorganized but in six years his energy and ability had thoroughly reorganized it and he left it in a prosperous and orderly condition. He died soon after his return to the United States. He wrote 'Memoirs of Samuel Bacon' (1822); and his own life was written by R. R. Gurley (1839).

ASHOCHIMI, ash-ō-chē-mē, or **WAPPO.** A tribe of North American Indians who formerly ranged in California from the geysers to Calistoga hot springs and in Knight's Valley.

ASHOKAN RESERVOIR, a pool formed by the Olive Bridge Dam across Esopus Creek 14 miles west of Kingston, N. Y., and 90 miles north of New York city. It forms part of the Catskill water system and has a capacity of some 132,000,000,000 gallons.

ASHRAF, ą-schräf', Persia, a town near the southern coast of the Caspian Sea, 56 miles west of Astrabad. It was a favorite residence of Shah Abbas the Great and was adorned by him with splendid buildings, of which only a few miserable ruins now remain.

ASHTABULA, Ohio, city in Ashtabula County, on Lake Erie, at the mouth of the Ashtabula River, 54 miles east of Cleveland, on the New York, C. & Saint Louis, the Pittsburgh, Y. & A. and the Lake Shore & M. S. railroads. It is the centre of an extensive agricultural and dairying region, largely settled by inhabitants of Finnish extraction, and has large manufactories of leather, woolen goods and farm implements. The United States census of 1914 reported 57 manufacturing establishments of factory grade employing 2,028 persons, of whom 1,864 were wage earners receiving a total of $1,345,000 annually in wages. The capital invested was $4,298,000 and the value of the year's output was $5,021,000: of this $2,206,000 was the value added by manufacture. It has a Carnegie public library, three national banks, city hospital and numerous large buildings. Its extensive railroad and lake commerce, facilitated by extensive river and harbor improve-

ments, makes it an important transfer shipping point, especially for iron and coal. The city was first settled in 1801, was organized as a township in 1805, incorporated in 1831, and received a city charter in 1892. On 29 Dec. 1876 a railroad accident here at a high bridge over the river resulted in the loss of over 100 lives. The city is governed under the commission-manager plan. Pop. 20,000.

ASHTAROTH, a goddess anciently worshipped by the Jews. Ashtaroth is the Astarté of the Greeks and Romans, and is identified by ancient writers with the goddess Venus (Aphrodite). She is probably the same as the Isis of the Egyptians. In Scripture she is almost always joined with Baal, and is called god, Scripture having no particular word for expressing goddess. She was the goddess of the moon; her temples generally accompanied those of the sun, and while bloody sacrifices or human victims were offered to Baal, bread, liquors and perfumes were presented to Astarté.

ASHTAROTH KARNAIM, supposed to be the modern Tell-Ashtarah, on the Bashan Plateau, 21 miles east of the shores of Lake Galilee. It is mentioned in Gen. xiv, 5. Consult Moore, 'Journal of Biblical Literature' (Vol. XV, p. 155, 1896).

ASHTAVAKRA, ash-tā-va'krā. In Hindu legend, the hero of a story in the Mahabharata. His father, Kahoda, devoted to study, neglected his wife. Ashtavakra, though still unborn, rebuked him, and the angry father condemned the son to be crooked (hence the name, from *Ashtan,* eight, and *vakra,* crooked). At the court of Janaka, King of Mithila, Kahoda was defeated in argument by a Buddhist sage and was drowned in accordance with the conditions. In his 12th year Ashtavakra set out to avenge his father, and worsted the sage, who declared himself to be a son of Varuna sent to obtain Brahmins to officiate at a sacrifice. Kahoda was restored to life, and commanded his son to bathe in the Samanga River, whence the boy becomes perfectly straight. In the Vishnu Purana some celestial nymphs see Ashtavakra performing penance in the water and worship him. He promises them a boon and they ask the best of husbands. When he offers himself they laugh in derision at his crookedness. He cannot recall his blessing, but condemns them to fall into the hands of thieves.

ASHTON, Algernon Bennet Langton, English composer: b. Durham, 9 Dec. 1856. In 1879 he graduated from the Conservatory at Leipzig, after which he took a special course in composition with Raff. In 1885 he was appointed professor of piano music at the Royal College of Music. He has composed three overtures, four symphonies, two string quartets, two quintets for wind instruments, several compositions for the organ, choruses and songs and many sonatas for piano solo, piano and violin, piano and 'cello and one sonata for piano and viola.

ASHTON, Lucy, the heroine of Sir Walter Scott's novel, 'The Bride of Lammermoor.' Engaged to a man she loves, she is forced to marry another, and dies a maniac on her wedding day.

ASHTON'-IN-MAK'ERFIELD, England, town of Lancashire, 15 miles from Manchester, and noted for its potteries, collieries and cotton mills. Pop. 21,543.

ASHTON-UNDER-LYNE, England, a market-town of Lancashire, six miles east of Manchester, on the north bank of the river Tame. It was an ancient Saxon town; the most interesting building is the parish church built in the reign of Henry V. Since 1769 it has grown rapidly through the extension of the cotton manufacture, both the spinning of cotton yarn and the weaving of calicoes being carried on in the town to a great extent. Upward of 20,000 work people are employed in factories. There are also collieries and ironworks in the neighborhood which employ a great many persons. Pop. 45,172.

ASHURST, Henry Fountain, American legislator: b. Winnemucca, Nev., 13 Sept. 1875. After attending the public schools of Flagstaff, Ariz., he began, in 1903, a special course in law and economics at the University of Michigan. In 1896 he became a member of the Arizona Territorial House of Representatives, of which he was chosen speaker two years later. After a term in the territorial Senate he became district attorney of Coconino County. On 27 March 1913, he was elected to the United States Senate by the unanimous vote of the first legislative assembly of the State of Arizona for a term ending in 1917.

ASIA, the largest of the five continental divisions of the earth, lying eastward of the European and African continents, and separated from the American continent by Bering Strait and the Pacific Ocean. It is wholly within the northern hemisphere, but some of the adjacent islands extend south of the equator. It is bounded north, east and south, respectively, by the Arctic, Pacific and Indian oceans, with their various branches and inlets; it is divided from Africa on the southwest by the narrow isthmian Suez Canal; and is connected with Europe on the northwest across the whole breadth of that continent. The natural western boundaries are the Ural Mountains, the Caspian Sea, Caucasus Mountains, the Black Sea, Ægean Sea, the Mediterranean and Red Seas. The sinuosities of the Asiatic coast are very extensive; on the south the chief ocean inlets are the Gulf of Aden; the Arabian Sea with its inlets, the Gulf of Oman, the Persian Gulf, and the Gulfs of Cutch, Cambay and Manar, and the Bay of Bengal containing the Gulf of Martaban. On the eastern or Pacific coast proceeding northward the principal indentations are the China Sea with the Gulfs of Siam and of Tonkin; the Tung-hai or Eastern Sea; the Hwang-hai or Yellow Sea with the Gulf of Pechili and Korea Bay; the Sea of Japan with the Gulf of Tartary; the Sea of Okhotsk, and Bering Sea with the Gulf of Anadyr. On the north or arctic coast are the Nordenskjold Sea and the Kara Sea with the Gulf of Obi. The coast line is about 35,000 miles, giving a proportion of one mile of coast line to 496 square miles of surface. From the extreme southwestern point of Arabia, at the Strait of Bab-el Mandeb to the extreme northeastern point of Cape Deshnef or East Cape, the length of Asia is about 6,900 miles, its breadth from Cape Chelyuskin or Northeast Cape in Siberia to Cape Romania, the southern extremity of the Malay Peninsula, is about 5,300 miles. The total area is estimated

ASIA
SCALES
Statute Miles, 660 = 1 Inch.
0 100 200 300 400 500 600 700 800
Kilometres, 1062 = 1 Inch.
0 200 400 600 800 1000 1200
Rand McNally's New 11 x 14 Map of Asia.
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ARCTIC OCEAN
BRITISH ISLES
NORTH SEA
NORWAY
SWEDEN
FINLAND
RUSSIA
EUROPE
GERMAN EMPIRE
AUSTRIA
HUNGARY
ITALY
ROUMANIA
BLACK SEA
CASPIAN SEA
MEDITERRANEAN SEA
ARABIA
PERSIA
AFGHANISTAN
BALUCHISTAN
TURKESTAN
TOBOLSK
TOMSK
AKMOLINSK
SEMIPALATINSK
KIRGHIZ STEPPE
URALSK
TURGAI
SYRIA
ARMENIA
EGYPT
LIBYAN DESERT
NEFUD DESERT
SYRIAN DESERT
RED SEA
ANGLO-EGYPTIAN SUDAN
ABYSSINIA
BRITISH EAST AFRICA
ITAL SOMALI LAND
BR SOMALI LAND
GULF OF ADEN
ARABIAN SEA
INDIAN OCEAN
BAY OF BENGAL
INDIA
CEYLON
EQUATOR
Longitude East

Bering Strait
BERING SEA
ALEUTIAN ISLANDS (To U.S.)
COMMANDER Is.
SEA OF OKHOTSK
KAMCHATKA
ANADYR
KORIAKS
YAKUTSK
YAKUTIA
BERIA
EMPIRE
MARITIME PROV.
STANOVOI MTS.
SAKHALIN
YEZO
HONSHU
JAPAN
JAPAN SEA
CHOSEN (KOREA)
MANCHURIA
AMUR
TRANSBAIKALIA
IRKUTSK
Lake Baikal
MONGOLIA
REPUBLIC
GOBI DESERT
Eastern Gobi
Ordos
CHINA
YELLOW SEA
EASTERN SEA
Wenchow SEA
Shanghai
Ningpo
Hangchow
Nanking
Hankow
Canton
Hong-kong (Br.)
Macao (Port.)
Bachi Channel
Balintang Channel
LUZON
PHILIPPINE ISLANDS (To U.S.)
CHINA SEA
PALAWAN
SULU SEA
MINDANAO
MALAYSIA
MALAY PENINSULA
BORNEO
CELEBES
CELEBES SEA
SUMATRA
Singapore (Br.)
Malacca
Strait of Malacca
BURMA
Rangoon
Mandalay
UPPER BURMA
ASSAM
Bhamo
Lhasa
Chengtu
Yunnanfu
Tonkin
Hanoi
Hue
Saigon
Bangkok
SIAM
Pnompenh
CAMBODIA
FRENCH INDO-CHINA
HAINAN
Hong-kong
Formosa
TAIWAN
Taihoku
Amoy
Foochow
Shanghai
Nanking
Tientsin
PEKINGHAI
Port Arthur
Dairen
Mukden
Kirin
Harbin
Vladivostok
Hakodate
Sapporo
Tokyo
Yokohama
Osaka
Kyoto
Nagasaki
Kagoshima
Naha
Ryukyu Is.
Bonin Is. (Jap.)
Volcano Is.
Marianne Islands (Ger.)
Guam (To U.S.)
Caroline Islands (Ger.)
Palau Is. (Ger.)
Yap
Pelew Is. (Ger.)
Schouten Is.
Bismarck Arch.
Kaiser Wilhelm Land (Ger.)
Dutch New Guinea or Papua
New Guinea or Papua (Br.)
Gulf of Papua
Banda Sea
Aru Is.
Molucca Sea
Celebes Sea
Sulu Sea
Strait of Malacca
Greenwich
EQUATOR
TROPIC OF CANCER
PACIFIC OCEAN
EMPIRE OF JAPAN
100°
120°
140°
160°
180°
60°
40°
20°
0°
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349

at 17,296,000 square miles. The most prominent features of the southern coast are the three great peninsulas of Arabia, India, and the Indo-Chinese Peninsula. The east coast is also flanked with insular and peninsular projections, forming a series of sheltered seas and bays. A series of large islands extends to the southeast of the continent, forming a connection with Australia; while a multitude of smaller islands are scattered over the Pacific and Indian oceans. The principal peninsulas on the east are Kamchatka and Korea. The larger islands, proceeding from the northeast coast, are Saghalien, the Japanese Islands, the Philippine Islands, Borneo, Sumatra, Java, Celebes, the Moluccas, Papua or New Guinea, which, however, is Australasian rather than Asiatic, and lastly Ceylon at the southeastern extremity of the Indian Peninsula. The Kurile Islands between Kamchatka and Japan, the islands of Loo Choo, Formosa and Hainan on the Chinese coast, and the Andaman and Nicobar Islands in the Indian Ocean, may also be noticed. On the west or Mediterranean coast the principal islands belonging to Asia are Cyprus and Rhodes. The northern coast, from East Cape or Deshnef, in Bering Strait, and on the Arctic Circle, to the Yalmal Peninsula, in the extreme northwest, is almost entirely contained within that circle. The highest point, Cape Chelyuskin, is about 78° N. The largest group of islands on the north coast is the Liakhov Islands (New Siberia); the largest indentation is the Gulf of Obi, which reaches below the Arctic Circle, and receives the river Obi about that latitude.

Mountains.—The mountain systems of Asia are of great extent, and their culminating points are the highest in the world. There are also vast plateaus and elevated valley regions, but large portions of the continent are low and flat. Such are the greater portions of Siberia, from the Ural Mountains across the north of the continent, and the western central region of the continent, where an area of great depression culminates in the Caspian. The greatest mountain system in Asia, and so far at least as altitude is concerned, of the world, is the Himalayan system, the principal mass of which lies between long. 65° and 110° E. and lat. 28° and 37° N. It thus occupies a position not very far from the centre of the continent, though nearer the southern edge than the northern. It extends, roughly speaking, from northwest to southeast, its total length being about 2,000 miles, while its breadth varies from 100 to 500 or 600. Different names have been given to different portions of the system, such as Hindu Kush (the northwestern extremity), Karakoram and Kuen-Lun, while Himalaya is more especially confined to the portion forming the northern barrier of Hindustan; but all these are really portions of the same connected mountain mass. The Kuen-Lun simply forms the northern flank of the mass, and is not, as it has been represented, a distinct chain; while the Karakoram Mountains have so little to distinguish them from the rest of the elevated mass to which they belong that they may be crossed without the traveler being aware of it. The broadest part of the system, the elevated tableland of Tibet, lies between the Himalaya proper and the Kuen-Lun. The Tibetan Mountains are connected on the east with the mountains of China and with those that spread to the southeast over the Indo-Chinese Peninsula. The Thian-Shan is another great mountain system of central Asia connected with the Himalayan system by the important Pamir Plateau or "roof of the world" in long. 70°–80° E.; lat. 37°–40° N. The point of junction forms "a huge boss or knot," from which the Thian-Shan runs northwestward for a distance of some 1,200 miles. Between these two systems, which curve round it on the west, lies eastern Turkestan, right in the centre of Asia. The greatest elevations of the Himalayan system are to be found among the Himalayas proper, where is Mount Everest, 29,002 feet high, Kunchinjinga, 28,156, etc. The principal passes here, which rise to the height of 18,000 to 20,000 feet, are the highest in the world. The Kuen-Lun summits reach a height of 22,000 feet. The Himalayas descend by successive slopes to the plain of northern India, which has an elevation of about 1,000 feet above the level of the sea. The Vindhyas cross the peninsula, dividing northern from southern India; the latter is further bounded by the eastern and the western Ghats, which run along the coasts; while the interior consists of elevated tablelands rising toward the south, where they attain in the neighborhood of the Nilgiri Hills an elevation of 7,000 feet. The Himalayas are not only connected with the mountains in the interior of India, and with ramifications into China and the Indo-Chinese Peninsula, but on the west with the mountains of Baluchistan and Afghanistan. The Suliman and Hala ranges bound India on the west, and unite with the mountains of Baluchistan; while the Hindu Kush, passing westward through the north of Afghanistan, has continuations more or less distinct through Persia to the Elburz range south of the Caspian, and so onward to Mount Ararat. From this point again it forms connections with the mountains of Armenia, with the Caucasus, with the Taurus range in Asia Minor, and with the mountains which run to the south of Persia. The mountains belonging to this series form the boundaries of an elevated plateau extending from the Mediterranean to the Indus. On the north they are frequently of great elevation, Mount Demavend in the Elburz range reaching the height of 18,460 feet, while Ararat is nearly 17,000. The Thian-Shan system is continued to the northeast by the Altai and Sajansk ranges, the whole separating the Chinese Empire from Russian Turkestan and Siberia. Tengri-Khan in the Thian-Shan Mountains is estimated to have a height of 21,320 feet. A line of moderate elevation extends from the Altai westward to the Ural Mountains. To the east of the Sajansk range the Yablonoi Mountains run northeast toward the coast, along which they are continued northward under the name of Stanovoi to Bering Strait.

Table-lands, Plains and Deserts.—Tibet forms the most elevated table-land in Asia, its mean height being estimated at 15,000 feet. Its surface is very rugged, being intersected by a number of mountain ranges running generally in an easterly and westerly direction. On the east it is bounded by lofty mountains which separate it from China. Some of the largest rivers of southern and southeastern Asia have

their origin in Tibet, including the Indus, the Brahmaputra, the Yang-tse and the Hoang-Ho. In this region a numerous series of lakes run in a chain parallel to the Himalayas. Another great plateau, much lower, however, than that of Tibet, is the plateau of Iran, occupying a large portion of western Asia, extending from the Indus to the Mediterranean, and from the Persian Gulf to the Caspian Sea. It comprises the countries known as Afghanistan, Baluchistan, Persia, Armenia and Asia Minor. It lies at altitudes varying from 2,000 to 8,000 feet above the sea. The eastern half of it consists to a large extent of unproductive wastes. Of great political and strategical importance at the junction of Turkestan, Afghanistan and India is the Pamir Plateau, already alluded to, called by the natives "the roof of the world." Its valleys are at an elevation of from 11,000 to 13,000 feet above the sea. Another table-land of smaller extent and elevation is the Deccan Plateau, India, south of the parallel of lat. 25° N. The principal plain of Asia, as already mentioned, is that of Siberia, which extends along the north of the continent and forms a vast alluvial tract sloping to the Arctic Ocean, and traversed by large rivers, such as the Obi, the Yenisei and the Lena, that convey its drainage to that ocean. Vast swamps of peat-mosses called tundras cover large portions of this region. Southwest of Siberia, and stretching eastward from the Caspian to the Thian-Shan Mountains, is a low-lying tract, consisting to a great extent of steppes and deserts, and including in its area the Sea of Aral, Bokhara, Khiva and other districts. This is a region of internal drainage, the rivers, among which are the Amu Daria and the Syr Daria, either falling into the Sea of Aral or into other smaller sheets of water. In the east of China there is an alluvial plain of some 200,000 square miles in extent, most of it productive and highly cultivated; in Hindustan there are plains extending for 2,000 miles along the south slope of the Himalayas; and between Arabia and Persia, watered by the Tigris and Euphrates, is the plain of Mesopotamia or Assyria, which could be made one of the richest in the world. Of the deserts of Asia the largest is that of Gobi, which is bounded on the north by the Yablonoi and Thian-Shan Mountains, on the south by Tibet, on the east by the Khingan Mountains on the borders of China; while in the west it extends into eastern Turkestan. Large portions of it are covered with nothing but sand or display a surface of bare rock. This desert forms a large part of the country known as Mongolia, the whole of which forms an area of internal drainage, deficient in rainfall. There are also extensive desert tracts in Persia, Arabia and Hindustan. An almost continuous desert region may be traced from the African desert through Arabia, Persia and Baluchistan to the Indus.

Rivers and Lakes.— Asia contains some of the largest rivers in the world. It is remarkable among the continents for the number of its rivers, some of them of large size, that never find their way to the ocean, their waters either being lost in the sand or falling into lakes that have no outlet. The chief rivers in western Asia are the Tigris and Euphrates, that rise in the Armenian plateau and fall into the Persian Gulf; the Indus, from the Tibetan plateau, flows through northwestern Hindustan and falls into the Arabian Sea; the Ganges, which rises in the Himalayas and flows eastward through northern Hindustan, and the Brahmaputra, which rises in Tibet and flows through Assam and Bengal, both enter the Bay of Bengal; the Irrawaddy and the Salwen, rising in the mountains of the Indo-Chinese Peninsula, and both flowing through Burma; likewise enter the Bay of Bengal; the Mekong or Cambodia, the largest river of this peninsula, has its sources in the same mountains, and flowing southeastward enters the south China Sea; the Yang-tse and the Hoang-Ho, the two great rivers of China, rise in the Tibetan plateau; and enter the ocean after a winding easterly course; the Amur, the only other great river of eastern Asia, rises in Mongolia, and after a circuitous course enters the Sea of Okhotsk; the great rivers of northern Asia, the Lena, Yenisei and Obi, have already been mentioned. The Yenisei is believed to have a length of 3,400 miles, the Yang-tse of at least 3,000, the Lena of 2,770, the Hoang-Ho of 2,600. The basin of the Obi, including of course those of its tributaries, the Tobol and the Irtish, is believed to be the largest of any river in the world, except the Amazon and the Mississippi, being considerably over 1,000,000 square miles in area.

The largest lake of Asia is the Caspian Sea, which, however, is partly in Europe, its largest tributary being the Volga. The chief Asiatic rivers falling into this sea are the Kur from the Caucasus, the Aras from Armenia, and the Atrek from northern Persia — the river Ural being partly European, partly Asiatic. The Caspian lies in the centre of a great depression, being 83 feet below the level of the Sea of Azof. East from the Caspian, as already mentioned, is the Sea of Aral, which, like the Caspian, has no outlet, and is fed by the rivers Amu Daria and Syr Daria. Its area is estimated at 27,000 square miles. Still farther east, to the north of the Thian-Shan Mountains, and fed by the Ili and other streams from this system, is Lake Balkash, a somewhat crescent-shaped sheet of water, with an area of 8,400 square miles. The lake has no outlet; its water is clear but very salt and disagreeable. There are also several other smaller lakes in this region, such as Issik-Kul, Kara-Kul, Ala-Kul, Baratala, etc. In the south of Siberia, between long. 104° and 110° E., is Lake Baikal, a mountain lake from which the Yenisei draws a portion of its waters; its area is estimated at about 12,500 square miles. In the very centre of the continent is the Lob Lake, or Lob Nor, to which all the drainage of eastern Turkestan converges, being conveyed to it by the Yarkand, Kashgar and other streams. These unite to form the Tarim River, which, from the source of the Yarkand, has a total length of over 1,200 miles. Lob seems to be rather a swampy tract than a lake proper. On the borders of Afghanistan, Persia and Baluchistan, is a similar swampy lake that receives the Helmund and other streams from Afghanistan. Of the numerous lakes in Tibet Dangra-yum Nor and Tengri Nor seem to be the largest; the former is 45 miles long and 25 broad.

Geology.— Though in population and history the most ancient continent, geologically speaking Asia is considered, as regards its present aspect, to be one of the newest. The principal mountain chains are composed largely of

ASIA
(Commercial)
SCALE
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80 Statute Miles to one inch.
Principal Products
Navigable Portions of Rivers
Most important Railroads
Most important Steamship Lines
Longitude 40° East from Greenwich
Latitude North
RUSSIAN EMPIRE
SIBERIA
CHINA
JAPAN
INDIA
PERSIA
ARABIA
TURKESTAN
MONGOLIA
TIBET
AFGHANISTAN
BALUCHISTAN
KIRGHIZ STEPPE
MANCHURIA
KOREA
FRENCH INDO CHINA
SIAM
BORNEO
CELEBES
PHILIPPINE IS.
CEYLON
ARCTIC OCEAN
PACIFIC OCEAN
INDIAN OCEAN
ARABIAN SEA
BAY OF BENGAL
CHINA SEA
SEA OF JAPAN
SEA OF OKHOTSK
BERING SEA
MEDITERRANEAN SEA
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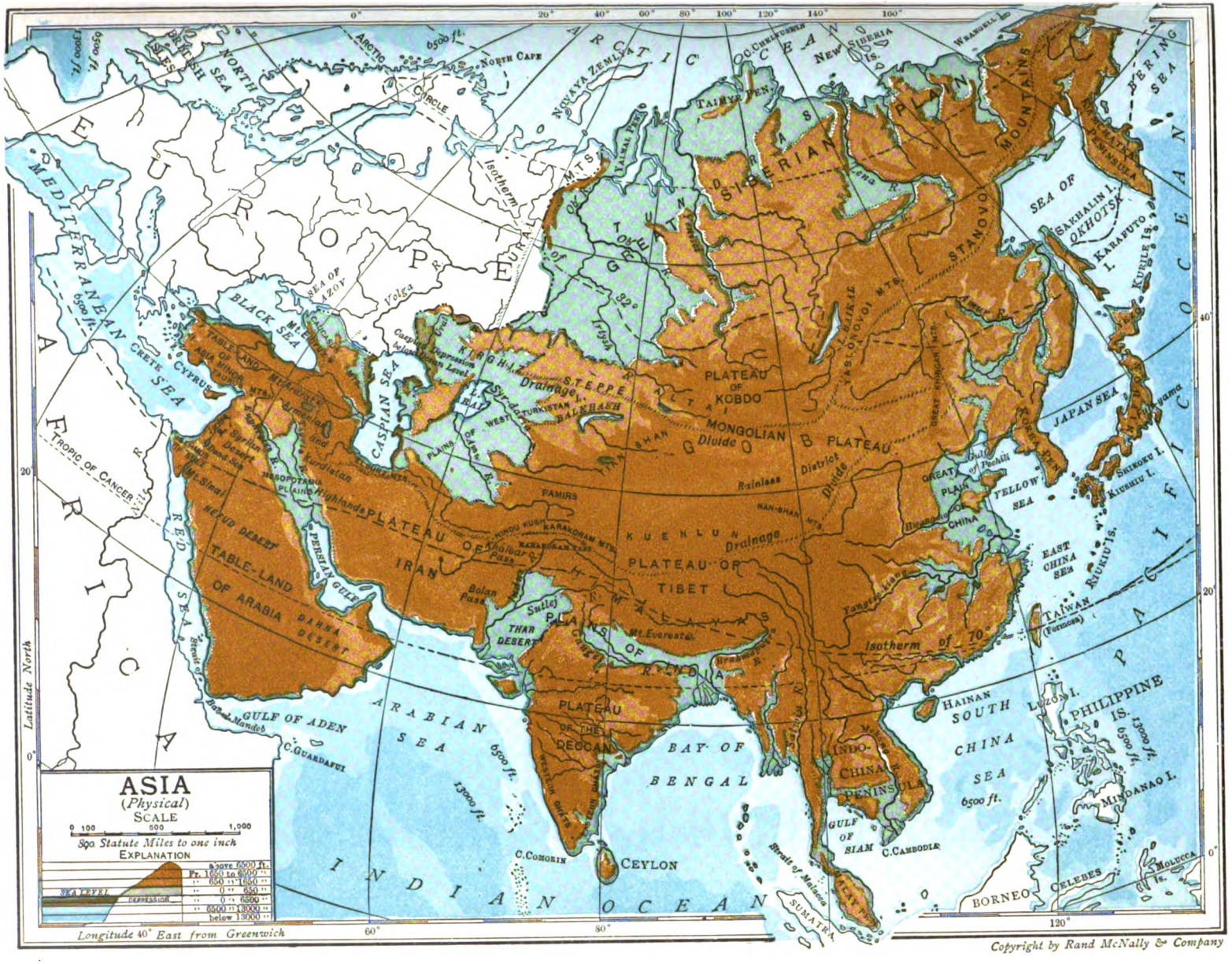

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ASIA

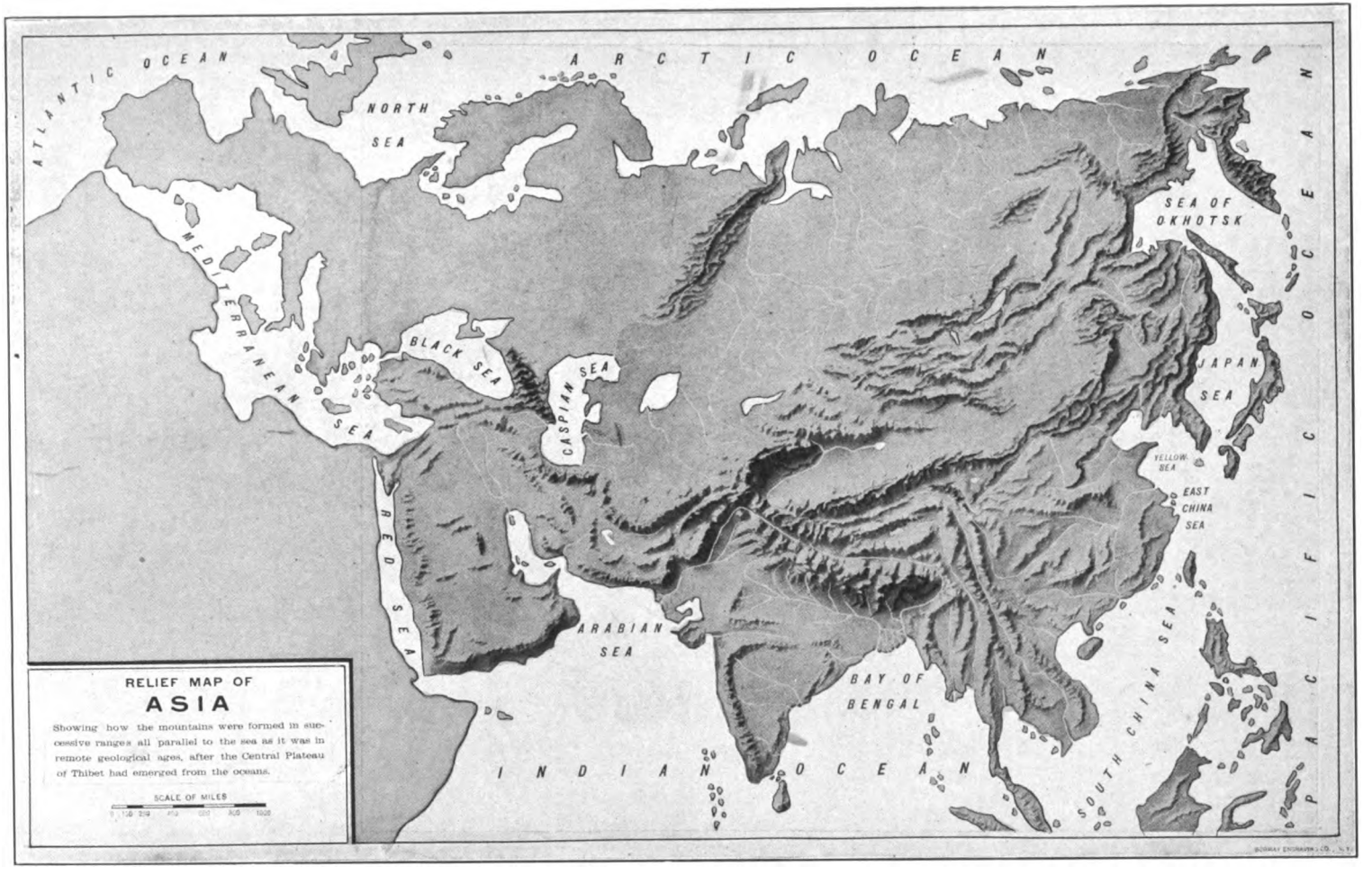
granitic rocks. The Himalayan range of mountains bears a striking resemblance in geological structure to the Alps; they are composed of granite gneiss and mica-schist, with syenite and amphibolites or trap-rocks, particularly primitive greenstone; the Altai Mountains contain granite in layers without alteration of gneiss, argillaceous schist in contact with greenstone, and containing augite, jasper, calcareous rocks, argentiferous lead ore and copper. The ramifications of the Altai into Russian Asia contain also coal-grit, schists, quartz and greenstone, rich with lead, silver and auriferous sand. The lower ranges are covered with transported layers of rolled stones of granite, gneiss and porphyry, in which are found agates, carnelians and chalcedonies. In the Kuen-Lun group are found rubies, lapis-lazuli and turquoises. In the eastern part of the Urals the granite, of which the chain is composed, along with gneiss and other rocks, is extremely rich in iron and copper. The Caucasus contains granite, argillaceous schist, basaltic porphyry, petroleum and gold, which is also found in Siberia, northern India, Siam, Borneo and Tibet. Diamonds and other precious stones are also found in Borneo as well as in India and Ceylon. The coal fields of China are perhaps the largest in the world. The great plains of northern India, Mesopotamia, central Asia and Siberia are regarded as of very recent geological origin. From various indications many geologists are of opinion that the greater part of western Asia was occupied at no very distant period by an ocean, of which the Caspian and Aral Seas are the remains. It is also conjectured that a continental area extending across the Indian Ocean united Asia during the Permian period to Africa and Australia. Siberia is supposed to have been twice submerged during the Palæozoic and the later Tertiary period. A line of volcanic action extends on the eastern coast from Kamchatka through the Philippines and the Malay Archipelago to Aracan in the Bay of Bengal. In Kamchatka there are eight or nine active volcanoes; in the interior of the continent there appear to be none at present active.

Climate, Soil, etc.— The size of Asia, the great altitudes and depressions of the continent, along with the variations of latitude and the disposition of sea and land, etc., afford an inexhaustible source of complexity in the variety and distribution of climate. In Tibet, with a mean elevation of about 15,000 feet, the climate is rigorous, combining great cold with drought; vegetation is scanty, trees almost absent and the population mostly nomadic; except in the lower valleys, where there is an agricultural population, it is very sparse. The climate of central Asia generally presents extremes of heat and cold and great deficiency of rain. It has accordingly a deficient vegetation and a scanty nomadic population. The great region of Siberia, which, as already mentioned, is a level or slightly undulating plain, lying wholly within the temperate and frigid zones, has a climate which generally resembles that of similar latitudes in Europe, with the exception of greater heat and drought in summer and greater cold in winter. The rainfall is very moderate, but the drainage is deficient and the soil often becomes swampy. The vegetation is scanty, consisting mostly of grasses and shrubs in the plains and pine forests on the mountains. There is very little land under cultivation and the population is very thin. The northern part of China to the east of central Asia has a temperate climate with a warm summer, and in the extreme north a severe winter. It is well watered and wooded, possesses a fertile and well-cultivated soil yielding the usual products of temperate regions, and is thickly peopled. The district lying to the south of the central region, comprising the two Indian peninsulas, southern China, and the adjacent islands, presents the characteristic climate and vegetation of the southern temperate and tropical regions. Here, however, the modifying effects of altitude come most largely into play, and every variety of climate and form of vegetation is to be found on the slopes of the Himalayas, and the mountains and plains of southern India and of the Eastern Peninsula. The part of Asia south of the Himalayas, though not all lying within the tropics, is all subject to tropical influences. Among the principal of these may be reckoned the effects of the tropical heat upon the air-currents. To this cause are due the trade-winds, which, carrying the moisture of the southern seas to the continents to be condensed by the mountain masses against which they strike, by determining the rainfall of the various continental districts, and affecting the size and course of the rivers, produce so many climatic effects. More local in their effects as well as arbitrary in their occurrence, and consequently fatal in their violence, are the cyclones, or circular storms, common in the Bay of Bengal and the China Sea. The normal directions of the monsoons are northeast and southwest; the northeast monsoon begins in October and the southwest in April; but the direction, duration and intensity of these winds are greatly modified, especially on land, by local circumstances. The soil of the southern regions is usually good, and where moisture is sufficient vegetation is rich and even exuberant. The soil of India is so finely comminuted that it has been said it is possible to go from the Bay of Bengal to the Indus and return again to the sea without finding a single pebble. The rainfall in those regions is extremely irregular. There are belts where hardly any rain falls at all, others of moderate and others of very heavy rainfall. On the Khasia Hills, to the northeast of the delta of the Ganges and Brahmaputra, the heaviest rainfall in the world takes place, the average fall observed being 550 inches a year. The principal period of rain is during the southwest monsoon. On the mountains which directly face the winds, charged with vapor as they come from the sea, the rain will fall in abundance, while they pass over intermediate plains without parting with their moisture. The rainfall, the course of the rivers and the irrigation and fertility of the plains of India are accordingly determined by the position of the Himalayas, the Ghats and other mountain ranges. The high plateau which extends from Asia Minor to the Indus has a temperate climate, with some extremity of heat in summer and cold in winter. Rain falls chiefly in winter and spring. The eastern part of this plateau is deficient in rain and the soil is poor and unproductive; the western portion, consisting of Asia Minor, is more favored of nature. The desert character of large parts of Arabia, Persia and Baluchistan has already been alluded to. Some parts of the coast of Arabia, as Yemen

and Oman, are fertile, but the greater part, especially on the Red Sea, is barren and desolate. A desert belt surrounds an interior plateau of 1,000 to 3,000 feet in height, and of moderate fertility. Syria is divided between hilly and fertile and low desert tracts. The Japanese Islands, which are traversed by mountains of considerable elevation and extend over about 15° of latitude, experience a great variety of climates. In the north the climate is rigorous, owing to the Siberian winds; in the south it is mild. The eastern coast is milder than the west, being sheltered by the mountain ranges from the cold winds of the continent. The country generally is fertile and populous. The character and productions of the other islands are mostly tropical.

A greater extreme of cold is reached in North America than in northern Asia, the mean temperature of the east coast of Siberia being above the zero of Fahrenheit; and the heat of southern Asia is less than that of Africa, which has more land lying within the tropics. In Siberia the extremes of temperature are great, exceeding 100° between the mean of the hottest and coldest month on the coast, and being commonly over 60° throughout the country. As the equator is approached the extremes of temperature diminish till at the southern extremity of the continent they approach within 5°. The highest temperature attained in southern Asia is about 112°, the highest mean about 82°. The summers of the northern latitudes, though shorter, attain a maximum of heat not much short of the tropics, the greater length of the day compensating for the less intensity of the midday heat. On the Persian plateau the summer heat is increased by the want of rain, and the severity of the winter by the elevation.

Vegetation.— The plants and animals of northern Asia generally resemble those of similar latitudes in Europe, though the extremes of climate are greater. The plateau extending from Asia Minor to the Himalayas resembles southern Europe in its productions, and the desert belt of Asia has an affinity to the African desert. The characteristic types of Siberia are continued to the high regions of central Asia. The community of type with European forms also extends to north China, where is developed besides a relation with the types of North America. The whole of northern Asia differs from Europe more in species than in genera of vegetable productions. Oaks and heaths are absent in Siberia. The principal mountain trees are the pine, larch and birch; the willow, alder and poplar are found in lower grounds. The cultivated plants of Asia Minor and Persia resemble those of southern Europe. In the central region European species reach as far as the western and central Himalayas, but are rare in the eastern. They are here met by Chinese and Japanese forms. The lower slopes of the Himalayas are clothed almost exclusively with tropical forms; higher up, between 4,000 and 10,000 feet, is the region of forests and cultivation, producing all types of trees and plants that belong to the temperate zone, and having extensive forests of conifers; in the east forest trees are met with at a height of 13,000 feet. Rhododendrons extend to 14,000 feet, and phanerogamous plants are found at the height of 19,500 feet. The southeastern region, including India, the Eastern Peninsula and China, with the islands, contains a vast variety of indigenous species, varying with the humidity of the climate and the elevation, the forms of higher latitudes being represented on the mountains. In this region we find growing wild a number of plants that have become of the utmost importance to man, such as the sugar-cane, rice, cotton and indigo, pepper, cinnamon, cassia, clove, nutmeg and cardamons, banana, cocoanut, areca and sago palms; the mango and many other fruits, with plants producing a vast number of drugs, caoutchouc and gutta-percha. The forests of India contain the oak, teak, sāl, deodar and other timber woods, besides bamboos, palms, sandal-wood, laurels, fig-trees, etc. The Malay Peninsula contains dense forests of similar kinds. The cultivated plants of India include wheat, barley, rice, maize, millet, sorghum, tea, indigo, jute, opium, etc. North of the tropic wheat is sown in November and reaped early in April, and a crop of rice or other tropical cereal is sown in June and July, and reaped in September and October. Wheat and barley do not grow in southern India, the winter not being sufficiently severe to prepare the ground for them. Cotton, indigo, sugar, tea, tobacco, coffee, pepper, plantains, mangoes, etc., are cultivated in China. Of the Chinese flora the larger portion resembles the Indian while much is local. In north China, the country between it and the Amur (Manchuria), and the Japanese Islands, large numbers of deciduous trees occur, such as oaks, maples, limes, walnuts, poplars and willows, the genera being European but the individual species Asiatic. Among cultivated plants are wheat, and in favorable situations rice, cotton, the vine, etc. Japan and the northern parts of this region are rich in species of the pine tribe. According to elevation the islands of the Asiatic Archipelago display an equal diversity with the mainland, the more tropical types being represented on the lower elevations, the more northern on the higher. Coffee, rice, maize, etc., are extensively grown in some of the islands. A line of demarcation called Wallace's line has been drawn at the Strait of Macassar, at which the flora and fauna of Australia begin to appear, and gradually become more pronounced as the distance from Asia and the proximity to Australia increases. The variety of plants of the desert region of Arabia, Persia and Baluchistan is comparatively small. The predominance of a few species gives character to the whole region. Vegetation is most abundant in spring, when herbaceous and bulbous plants, which extend through this region from Syria to the Himalayas, are abundant. In Arabia Felix and the warmer valleys of Persia, Afghanistan and Baluchistan, where the hills are high enough to afford a sufficient rainfall, aromatic shrubs are abundant. Wheat, barley, cotton and indigo are cultivated in Arabia, and the date-palm flourishes in the desert. On the mountain slopes of western Arabia (Arabia Felix) the coffee-plant, which has probably been derived from Africa, is cultivated. Gum-producing acacias are, with the date-palm, the commonest trees in Arabia; the latter also extends through Persia, and even reaches the shore of the Caspian. Fleshy plants are characteristic of the most arid portions. In the higher parts of Persia and Afghanistan numerous forms of *Umbelliferæ* of great size, as well as thistles and the borage tribe, are


ATLANTIC OCEAN
ARCTIC OCEAN
NORTH SEA
MEDITERRANEAN SEA
BLACK SEA
CASPIAN SEA
RED SEA
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
SEA OF OKHOTSK
JAPAN SEA
YELLOW SEA
EAST CHINA SEA
SOUTH CHINA SEA
PACIFIC OCEAN
RELIEF MAP OF
ASIA
Showing how the mountains were formed in successive ranges all parallel to the sea as it was in remote geological ages, after the Central Plateau of Thibet had emerged from the oceans.
SCALE OF MILES
0 150 300 450 600 750 900 1050

abundant. African forms are found not only extending from the African desert along the desert region of Asia, but from south Africa to Ceylon. The Caspian lowlands are the tract where the saline vegetation that is spread over the whole region of steppes and deserts has its greatest development. This region is regarded as the native country of the melon.

Zoology.— There is a still closer resemblance in the fauna than in the flora of northern Asia to that of Europe. Asia south to the Himalayas, together with Europe and north Africa, forms a continuous region, which Dr. Sclater has designated as the Palæarctic; southeastern Asia, with Sumatra, Java, Borneo and the Philippines, he calls the Indian region; Africa south of the Atlas, with Arabia, Palestine, south Persia, the dry part of Baluchistan and Sind, form the Ethiopian region; Celebes and the other islands beyond Wallace's line, with Australasia, the Australian region. Nearly all the mammals of Europe occur in northern Asia, with numerous additions to the species. *Quadrumana* are rare, *Carnivora* numerous, especially bears, wolves and weasels. Moles, shrews and hedgehogs are common among *Insectivora*. Rodents are represented by marmots, the pika, jerboas, rats, mice, etc. There are numerous species of wild sheep, antelopes and deer. Of the last, the musk and many others are characteristic. In the Indian region there are several peculiar genera of the *Quadrumana* or monkey tribe. Among the distinctive forms of this region is the elephant, the Asiatic species being distinct from the African. The lion, tiger, leopard, which are considered as Ethiopian forms, the bear, civets, ichneumons and other carnivorous animals are found. The lion inhabits Arabia, Persia, Asia Minor, Baluchistan, etc., and extends as far east as India, being now, however, confined to Guzerat. The tiger is the most characteristic of the larger Asiatic *Carnivora*. It extends from Armenia across the entire continent, being absent, however, from the greater portion of Siberia and from the tableland of Tibet; it extends also into Sumatra, Java and Bali. The horse, ass and camel have their true home in Asia. In the Indian region we also find the rhinoceros, buffalo, ox, deer, squirrels, porcupines, as well as various species of *Edentata*. The avifaunas of Europe and northern Asia are identified to a still greater extent. A large number of European species extend over northern Asia as far as Japan. In the Malay Archipelago marsupial animals first occur in the Moluccas and Celebes, while various mammals common in the western part of the archipelago are absent. A similar transition toward the Australian type takes place in the species of birds. Of marine mammals the dugong is peculiar to the Indian Ocean; in the Ganges is found a peculiar species of dolphin. In birds, nearly every order except ostriches is represented. Among the most interesting forms are the hornbills, the peacock, the Impey pheasant, the tragopans and other gallinaceous birds, the pheasant family being very characteristic of the region. The pheasant proper in the wild state is peculiar to northern Asia, the golden pheasant and several other species of pheasants to the northeast. The genera and species of passerine birds are very numerous. The desert region, extending from Arabia to Sind, is chiefly distinguished by the absence of many Indian forms and the presence of some African ones, which, however, are not widely spread, most of them being limited to Arabia and Syria. The chief haunts of the *Reptilia* of Asia are the northern portion of Hindustan, the southeastern peninsula, China and the islands of Ceylon, Sumatra and Java. At the head of the reptiles stands the Gangetic crocodile, frequenting the Ganges and other large rivers; the helmeted crocodile and the double-crested crocodile are numerous in various quarters, both insular and continental. Among the serpents are the cobra de capello and the Ceylonese tic-palonga, both among the most deadly snakes in existence; there are also very large pythons, besides sea and fresh-water snakes. There are also a number of species of frogs and toads and of fresh-water tortoises as well as many terrestrial and aquatic lizards. The seas and rivers of Asia produce a great variety of fish. The *Salmonidæ* are found in rivers flowing into the Arctic and north Pacific oceans, but not in southern Asia. Large numbers are caught. Trout are found in the feeders of the Indus and the Caspian. Sturgeons abound in the Black Sea and the Caspian. Two rather remarkable kinds of fishes are the climbing perch and the eriapthalmus. The well-known gold-fish is a native of China.

Asiatic Races.— The Mongolian race is the most numerous in Asia, and includes about two-thirds of the inhabitants. It occupies the Chinese empire, Tartary and probably Japan, with part of the Indo-Chinese Peninsula. It is partly settled, as in China, Japan and the peninsula; partly nomadic, as in Tartary and Mongolia. The Aryan is the next in numbers, and the most civilized of the Asiatic races. It was until the Mohammedan conquest the dominant, as it is still the most numerous, race in India. It also prevails in Persia and in the middle region from Afghanistan to Asia Minor. The Semitic race is widely spread in Arabia and southwestern Asia, and formerly at least extended to Africa. The black race is represented by the Negritos of the Philippines, the Papuans and some tribes of the Malay Peninsula. The Dravidian race in south India, the Malays in the Eastern Peninsula, the Ainos of Japan and other races locally distributed, have no well-defined relation with the larger races. The Dravidians are variously associated with the Mongols and the Australians. The latter theory is connected with the hypothesis of a southern continent, which also connects these races with Africa. See ETHNOLOGY.

Political Divisions.— A large portion of Asia is under the dominion of European powers. Russia possesses the whole of northern Asia (Siberia) and a considerable portion of central Asia, together with a great part of ancient Armenia, on the south of the Caucasus; in all an area of 6,294,119 square miles with a population of (1913) 27,788,000. Turkey holds Asia Minor, Syria and Palestine, part of Arabia, Mesopotamia, Kurdistan, Armenia, Hejaz and Yemen in Arabia, with a total area of 699,342 square miles and a population of 19,382,900. Great Britain rules over India, Ceylon, a part of the Indo-Chinese Peninsula (Upper and Lower Burma), Aden, Cyprus, Hongkong, etc., in all an area of 1,969,065 square miles, with a population of over 323,000,000; France has acquired a considerable

portion of the Indo-Chinese Peninsula (Cochin-China, Anam, Tonkin, Cambodia) and has besides Pondicherry and four other colonies in India, making a total area of about 256,200 square miles with a population of about 17,000,000, while to Holland belong Java, Sumatra and other islands or parts of islands in the Asiatic or Malay Archipelago, with an approximate area, including New Guinea, of 736,400 square miles and a population of about 38,000,000. The chief independent states are the Chinese Republic and its dependencies, including Mongolia and Tibet, occupying an area of about 3,913,560 square miles with a population estimated at about 320,650,000. Japan, including Korea, Formosa, Sakhalen, Pescaclores, with an area of 260,738 square miles and a population of about 70,000,000; Siam, area about 195,000 square miles, population about 8,149,000; Afghanistan, area about 250,000 square miles, population about 6,000,000; Persia, area about 628,000 square miles, population about 9,500,000, and the Arabian states occupying about 5 per cent of the area of Asia. The total population of the continent is estimated at 918,000,000.

Religions.— Asia has been the birthplace of religions; the Jewish, Buddhist, Christian and Mohammedan having their origin in Asia, where they grew up under the influence of still older religions, the Babylonian and that of Zoroaster, both also of Asiatic origin. At present it is estimated that there are 138,000,000 Buddhists in Asia, 210,000,000 Hindus (chiefly in India), 142,000,000 Mohammedans (in western and part of central Asia), 300,000,000 Confucianists and Yavists (chiefly in China), 17,200,000 Orthodox Greeks and Armenian Catholics (in Armenia, Siberia, Caucasus and Turkestan), 5,500,000 Roman Catholics and 6,000,000 Protestants. Roman Catholic and Protestant missions are established in almost every part of Asia, particularly in India, China and Japan. About 500,000 Jews are scattered mostly in western and central Asia. A few fire-worshippers, Guebers or Parsis of India and Persia are the sole remnant of the religion of Zoroaster; while vestiges of Sabæism are found amidst the Gesides and Sabians on the Tigris.

Civilization.— There are to be found in Asia all varieties of civilization, the primitive tribes of northeastern Siberia, the confederations of nomadic shepherds and great nations in possession of a common stock of national customs, beliefs and literature, like China; the tribal stage; the compound family, forming the real basis of China's social organization; the rural community, both of the Indian and Mussulman type; the loose aggregations of Tchuktchis (northern Siberia), having no rulers and no religion beyond the worship of forces of nature, but professing with regard to one another principles of morality and mutual support often forgotten in higher stages of civilization; and despotic monarchies with a powerful clergy. So also in economic life. While the tribes of the northeast find their means of subsistence exclusively in fishing and hunting, carried on with the simplest implements, among which stone weapons have not yet quite disappeared, and the tribes of central Asia carry on primitive cattle-breeding and lead a half-nomadic life, others are agriculturists, and have brought irrigation (in Turkestan) to a degree of perfection hardly known in Europe.

Internal Communication.— Caravans of camels are the chief means of transport for goods and travelers in the interior; donkeys, yaks and even goats and sheep are employed in crossing the high passages of the Himalayas; human porters and mules are the usual means of transport in most parts of China, horses in Siberia, and in the barren tracts of the north the reindeer, and, still farther north, the dog, are made use of. Fortunately the great rivers of Asia provide water communication over immense distances. The deep and broad streams of China, allowing heavy boats to penetrate far into the interior of the country, connect it with the sea; a brisk traffic is carried on along these arteries. In Siberia the bifurcated rivers supply a waterway, not only north and south along the course of the chief rivers running toward the Arctic Ocean, but also west and east; thus a great line of water communication crosses Siberia, and is, with but few interruptions, continued in the east by the Amur, navigable for more than 2,000 miles. In the winter the rivers and plains of Siberia become excellent roads for sledges, on which goods are still chiefly transported.

Railways.— In 1912 the lines in existence had a total length of about 63,320 miles, of which 32,667 miles belonged to British India and Ceylon, 10,586 to Asiatic Russia and 5,420 miles to China, about 1,300 miles of which was constructed by British capital. The lines are very remunerative, especially that from Peking to Tien-Tsin. Japan is well provided with railroads, the length being 6,093 miles (including Korea) in 1912. In the same year the French possessions in Cochin-China, Anam and Tonkin had 2,178 miles, the Dutch Indies 1,551 miles, Siam 637 miles. There are as yet no railroads in Persia of any consequence; but in 1914 there were 2,836 miles in Asiatic Turkey, not including the most recently opened sections of the Bagdad Railway, which is being constructed by German capital and is to extend the Anatolian line from Kornia to Adana, Mosul, Bagdad and Basra, with many branch lines. The great Trans-Siberian Railway connecting Moscow and Petrograd with Vladivostok and Port Arthur was completed in 1904.

Telegraph communications are in a much more advanced state than the roads. Petrograd is connected by telegraph with the mouth of the Amur and Vladivostok (on the frontier of Korea); while another branch, crossing Turkestan and Mongolia, runs on to Tashkend, Peking and Shanghai; Constantinople is connected with Bombay, Madras, Singapore, Saigon, Hongkong, and Nagasaki in Japan; and Singapore stands in telegraphic communication with Java, and Port Darwin in Australia. Finally, Odessa is connected by wire with Tiflis in Caucasus, Teheran and Bombay.

Trade.— Notwithstanding the difficulties of communication a brisk trade is carried on between the different parts of Asia, but there is no possibility of arriving at even an approximate estimate of its aggregate value. The maritime exports to Europe, the United States, and overland to Russia, have an annual value of about $900,000,000, and the imports of about $750,000,000. The bulk of the enormous trade between Great Britain, India, China and Japan

is carried on via the Suez Canal, opened 1869, and there is a steadily growing over-sea trade between China and Japan and the Pacific ports of the United States and Canada. Asia deals chiefly in raw materials, gold, silver, precious stones, petroleum, teak and a variety of timber-wood, furs, raw cotton, silk, wool, tallow and so on; the products of her tea, coffee and spice plantations; and a yearly increasing amount of wheat and other grain. Steam industry is only now making its appearance in Asia, and, although but a very few years old, threatens to become a rival to European manufacture. Indian cottons of European patterns and jute-stuffs already compete with the looms of her European sister countries. Several of the petty trades carried on in India, China, Japan, Asia Minor and some parts of Persia have been brought to so high a perfection that the silks, printed cottons, carpets, jewelry and cutlery of particular districts far surpass in their artistic taste many like productions of Europe. The export of these articles is steadily increasing, and Japan supplies Europe with thousands of small articles — applications of Japanese art and taste to objects of European household furniture.

History.— The origin of the name Asia is involved in obscurity, and it is not certainly known whether it arose among the Greeks or was borrowed by them from some Asiatic people. Modern scholars are inclined to believe that the name Asia is connected with the Sanskrit *ushas*, the dawn, as Europe may be connected with the Hebrew *ereb*, the west or the sun-setting.

The oldest historical documents are of Asiatic origin, and next to the immediately contiguous kingdoms of Egypt, Asia possesses the oldest historical monuments in the world.

The oldest historical monuments in Asia are those of Assyria (see ASSYRIA), and with them are associated traditions which carry us back to a remote and indefinite antiquity. A similar vague antiquity belongs to the historical traditions of India and China. Criticism, however, reduces all these claims to moderate dimensions, and assigns to the oldest ascertained facts a period not more remote than some 4,000 years from the present.

The earliest facts in the history of Asia, apart from documents and monuments, consist in the migrations of races, the evidence of which is derived from tradition, from language, from customs and from religion. The earliest known seat of the Aryan race was on the banks of the Oxus. Hence probably from the pressure of the Mongolian tribes to the north they spread themselves to the southeast and southwest, pressing upon the Dravidian inhabitants of India and the Semitic races of southwestern Asia. Finally they drove the Dravidians to the south of India and occupied Persia and other parts of western Asia, spreading into Europe. It is a remarkable circumstance that in this invasion the Aryans appear to have acquired the use of letters from the peoples with whom they came in contact, the Dravidian letters being borrowed in India and the Semitic in Persia as the original basis of the Sanskrit and Zendic alphabets. At a later period the Greeks likewise adopted a Semitic alphabet from the Phœnicians. The Semites have spread within historical times into northern Africa, and their migrations had probably taken a similar course before they were recorded in history. A large portion of the Mongols are still, as they have always been, a nomadic race, and their migrations, carrying everywhere the terror of predatory arms, have spread from the settled part of their own race in China along the north of Asia into northern Europe.

The early religion of the Aryan race,— a nation of shepherds,— divided itself after their separation into two related but widely different developments, Brahmanism and Zoroastrianism (see INDIA (*Religion*); ZEND-AVESTA). The former became rich in mythological, theological and philosophical literature; but historical literature properly so called is wanting, and consequently there is a great absence of certainty with regard to the dates of early events. The war which the Mahâbhârata (see SANSKRIT LANGUAGE AND LITERATURE) professes to narrate is believed to be the earliest event in Indian history that can be regarded as historical, and probably took place about 1200–1400 B.C. In China authentic history extends back probably to about 1100 B.C., with a long preceding period of which the names of dynasties are preserved without chronological arrangement. The kingdoms of Assyria, Babylonia, Media and Persia alternately predominated in southwestern Asia. The arms of the Pharaohs also extended into Asia, but their conquests there were short-lived. From Cyrus (B.C. 559), who extended the empire of Persia from the Indus to the Mediterranean, while his son, Cambyses, added Egypt and Libya to it, to the conquest of Alexander (B.C. 330), Persia was the dominant power in Asia. The administration of Persia was not without vigor and policy, yet the Macedonian conquest was an event of great importance to Asia, bringing it, along with northern Africa, into closer relation with the more advanced and progressive continent of Europe. The division of Alexander's empire led to the protracted struggle between the Greek dynasties of Egypt and Syria, which ended in the absorption of both kingdoms in the Roman empire. After the unfortunate issue of the second Punic War Hannibal took refuge with Antiochus the Great of Syria, who, in the course of his conquests, had come in contact with the Romans, and was at length incited to try his strength with them. In the course of the war with Antiochus, L. Scipio, together with his brother, the conqueror of Carthage, passed into Asia. The kingdom of Antiochus was spared after his overthrow; but in B.C. 65 Syria became a Roman province. The Roman empire ultimately extended to the Tigris.

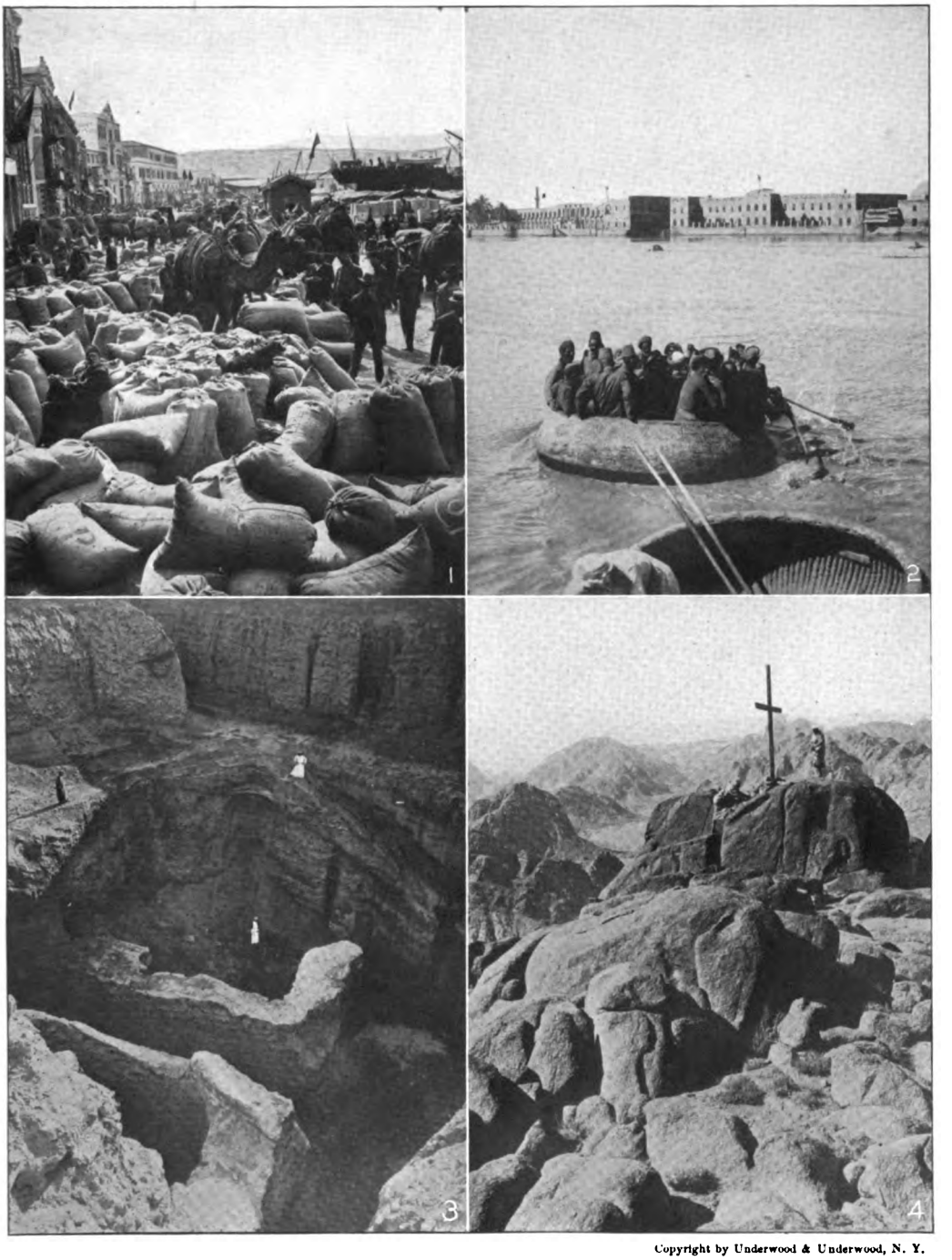
The knowledge of Asia possessed by the Greeks and Romans was at its widest extent very limited. The countries with which they were best acquainted were naturally in the west. China they knew as the country of the Seres or Sinæ, and the northern portions of the continent, inhabited by predatory Mongol tribes, were vaguely designated as Scythia. Of India the northwestern and western parts were known, and Ceylon likewise, under the name of Taprobane. The country traversed by the Hindu Kush and the sources of the Oxus, was known as Bactria; that between the Oxus and the Jaxartes as Sodgians; a large and vaguely defined central district, including Persia, was known as Ariana. Ptolemy had some acquaintance with

the Indian Peninsula, with the table-land of central Asia, with the Himalayas (Imaus) and China. The better known countries of the southwest comprised Asia Minor, Armenia, Arabia, Persia, Media, Parthia, Mesopotamia, Babylonia, Assyria, Syria.

Soon after the most civilized portions of the three continents had been reduced under one empire the great event took place which forms the dividing line of history. Christianity spread rapidly in the Roman empire; but Armenia was the first country which received it as a national religion. In A.D. 226 the Parthian monarchy which had arisen in eastern Persia about B.C. 250, and had disputed the empire of Asia with the Romans, was overthrown by the revived Persian dynasty of the Sassanidæ. The empire of Asia was now disputed with the Romans by the Persians. In the revived Persian empire the Magian religion was restored, and after the establishment of Christianity in the Roman empire religious jealousy embittered the feud between the two powers. The possession of Armenia was the subject of a protracted struggle between them; but its religion inclined it to the Roman alliance. The Tigris formed the most permanent boundary between the two empires, neither being able long to maintain any conquests beyond it. Christianity was persecuted in the Persian empire, and could not extend itself freely beyond the Roman limits. After the division of the Roman empire (A.D. 364) the struggle continued between the eastern and the Persian empires until the rise of a new power destined to absorb them both. While the eastern empire was struggling more and more feebly with the Persians, the Mongols and the barbarians of Europe, a new religion arose in Arabia (A. D. 622), which gathered around it a band of enthusiasts, small at first, but inspired with the most ardent zeal of proselytism. The central tenet of the unity of God gave them the sympathy of the Monophysite sect, which, persecuted in the empire, was powerful in Egypt, Syria, Mesopotamia and Armenia. Arabia, the country of the Prophet, soon gave its adherence to the new faith. The sword was consecrated as the instrument of its propagation. Persia, was the first great conquest of the Arabians. Syria and Egypt soon fell before their arms, powerfully aided by the defection of the heretics of the empire, and within 40 years of the celebrated flight of Mohammed from Mecca, which constitutes the era of his followers, the sixth of the Caliphs, or successors of the Prophet, was the most powerful sovereign of Asia. Heraclius, one of the most warlike, and in the early part of his reign one of the most successful of the eastern emperors, had succumbed to this torrent of conquest, and his successors trembled at the names of their rivals. The successors of Mohammed were at first austere and simple in their manners, and narrow and zealous in their religious faith; but from the accession of Moawiyah (A.D. 661), the time when the seat of empire was transferred first to Damascus and subsequently to Bagdad, the throne of the Caliphs was as splendid as it was powerful. The generous blood of Arabia, nourished by more genial climes, showed an aptitude for all that is great, not only in military achievement, but in learning, science, literature and art. The empire was soon divided, but wherever the Arab sway prevailed a liberal patronage of learning and toleration even of speculative inquiry distinguished it. The career of conquest was not soon ended. It spread with astonishing rapidity over Africa and Europe, and was finally checked only by the fatal divisions which originated in the disputes between the descendants of the Prophet and the dynasty of the Ommiades, descended from his mortal foe and tardy convert, Abu Sophian.

Among the alternate protectors and oppressors of the eastern Roman empire were the various Mongol tribes, whose predatory course led them to the west. In these also the Arab rulers found dangerous converts, who first supplied the place of their own troops, grown effeminate with luxury, and then planted themselves on the throne of which they had superseded the natural defenders. While the Caliphs of Bagdad still held a nominal sway, subject to the dictation of their Turkish guards, Mahmud, the Mongolian Mohammedan ruler of Ghazni, asserted his independence (999), conquered India, and established the Mohammedan power in the Punjab. Another revolt from the empire of Mahmud founded the Seljuk dynasty, which established itself in Aleppo, Damascus, Iconium and Kharism, and which was distinguished for its struggles with the Crusaders. Othman, an emir of the Seljuk Sultan of Iconium, established the Ottoman empire in 1300. About 1220 Genghis Khan, an independent Mongol chief, made himself master of central Asia, conquered northern China, overran Turkestan, Afghanistan and Persia; his successors took Bagdad and extinguished the remains of the caliphate. In Asia Minor they overthrew the Seljuk dynasty. His grandson, Kublai Khan, conquered China in 1260. The successors of Genghis Khan also invaded Russia, and the Christian empire established by Vladimir was overthrown by the Golden Horde, led by his grandson Batu (1240). Timur or Tamerlane, who professed to be a descendant of Genghis, carried fire and sword over northern India and western Asia, defeated and took prisoner Bajazet, the descendant of Othman (1402), and received tribute from the Greek Emperor. The Ottoman empire soon recovered from this blow, and Constantinople was taken and the eastern empire overthrown by the Sultan Mohammed II in 1453. A descendant of Timur, Baber, again invaded India early in the 16th century, and his grandson, Akbar the Great (1556–1605), founded the Mogul empire at Delhi, for two centuries one of the most brilliant Asia has known. China recovered its independence about 1368 and was again subjected by the Manchu Tartars (1618–45), soon after which it began to extend its empire over central Asia. Siberia was conquered by the Cossacks on behalf of Russia (1580–84) The same country effected a settlement in the Caucasus about 1786, and has since continued to make steady advances into central Asia. The discovery by the Portuguese of the passage to India by the Cape of Good Hope led to their establishment on the coast of the peninsula (1498) and opened a new era in the history of the East, which had been practically isolated from the West since the time of the Crusades. They were speedily followed by the Spanish, Dutch, French and British. The struggle between the last two powers for the supremacy of India was completed by the destruction of

ASIA



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1 Smyrna. Scene along the busy Harbor-front
2 The Tigris River at Bagdad and the "Kufas" or circular ferry-boats
3 Foundations of the Tower of Babel, Babylon
4 Scene in Mt. Sinai Valley. The Rock from which Moses read the Ten Commandments

the French settlements (1760–65), and from that time the conquest of India by the British progressed with uninterrupted success. In 1858 India came directly under the British Crown. The extension of the influence and possessions of European powers, especially Russia, Great Britain and France; Germany's seizure of Kiau-Chau in the Chinese province of Shantung in 1897; the rapid development of Japan into a power capable of competing on equal terms with those of Europe, as demonstrated by the victories over China (1895) and Russia (1904–05), the annexation of Korea (22 Aug. 1910), and capture of Kiau-Chau from Germany (7 Nov. 1914); the conquest of the Philippine Islands from Spain by the United States (1899); the Boxer rebellion (1900–01); overthrow of the Manchu dynasty in China and proclamation of the Chinese Republic (12 Feb. 1912); the Japanese demands considered menacing to the independence of China and the agreement of 8 May 1915 between the two nations; the participation of Turkey in the European War on the side of the Central Powers are the most important events in modern Asiatic history. For particular phases of this history see CHINA; KOREA; JAPAN; MANCHURIA; RUSSIA and TURKEY. Also BOXERS and TRIPLE ALLIANCE.

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ASIA, Central, a designation loosely applied to that enormous region of Asiatic territory lying between the Altai Mountains and the Persian Gulf, and includes part of Siberia, all Turkestan, Afghanistan, Baluchistan and part of Persia. Humboldt's definition of central Asia gave that name to the khanates of Bokhara and Tartary. In Russian official language, central Asia is an administrative portion of the empire lying to the southwest of Siberia and comprises with part of what used to be called Siberia the recent Russian annexations in Turkestan. The total area is given at 1,366,000 square miles and the population at 11,135,500. The eastern portion belongs to China; the western or Russian portion is divided into the governments of Akmolinsk, Semipalatinsk, Turgai, Uralsk, Semirechinsk, Ferghana, Samarkand Syr-Daria and the Trans-Caspian territory. For the geography, ethnography, etc., of the region see ASIA; also TURKESTAN, KHIVA, KHOKAND, SIBERIA, RUSSIA, etc. Consult Cobbold, R. P., 'Innermost Asia' (London 1900); Knight, E. F., 'Where Three Empires Meet' (London 1893); Krafft, H., 'A travers le Turkestan Russe' (Paris 1901); Meakin, Annette, 'In Russian Turkestan' (London 1915); Phibbs, I. M., 'A Visit to the Russians in Central Asia' (London 1899); Skrine, F. H., 'The Expansion of Russia' 1815–1900 (London 1903). *Bokhara:* Curzon, G. N. (Lord), 'Russians in Central Asia' (London 1889) and 'The Pamirs and the Source of the Oxus' (London 1897); O'Donovan, E., 'The Merv Oasis' (London 1889); Vambery, A., 'History of

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ASIA, in the Bible. In the Old Testament there is no reference to Asia, but in the Apocrypha it is applied to the territory covering the Tigris and the Euphrates valleys, part of Asia Minor, Syria, Phœnicia and Palestine, practically the same countries to which the Romans applied the name. Consult Acts xix, 10, 26, which refers to Paul laboring in Ephesus, chief city of the Biblical Asia. Paul addressed the circular epistle to the churches of this region, for reference to which see the closing salutation of Corinthians (which was written from Ephesus) xvi, 19. They are also made the recipients of the message of John in the Book of Revelation.

ASIA MINOR ("Asia the Less"). Modern Anatolia is the extreme western peninsula projection of Asia, forming part of Turkey in Asia. The name is not very ancient; originally the Greeks seem by Asia to have meant only the western part of Asia Minor, but with their geographical knowledge the scope of the name Asia gradually widened. The late Greek name for Asia Minor is Anatolia—*Anatolé,* "the East," whence is formed the Turkish Anadoli. Asia Minor includes the peninsula; it is bounded on the north by the Black Sea and Sea of Marmora, on the west by the Ægean Sea, on the south by the Mediterranean and on the east by the Armenian highlands and the Euphrates. In the extreme northwest it is separated from Europe by the Straits of the Bosporus and the Dardenelles. The western coast is indented with innumerable bays and gulfs, beyond which lie the islands of the Grecian Archipelago. The area of the peninsula is about 199,272 square miles. It constitutes the western prolongation of the high table-land of Armenia with its border mountain ranges. The interior consists of a great plateau or rather series of plateaus, rising in gradation from 3,500 to 4,000 feet, with bare steppes, salt plains, marshes and salt lakes; the structure is volcanic and there are several conical mountains, one of which, the Ergish-dagh (Argæus), with two craters, attains a height of 13,100 feet, towering above the plain of Kaisarieh which has itself an elevation of between 2,000 and 3,000 feet. The plateau is bordered on the north by the Pontic Coast range, a long train of parallel mountains 4,000 to 6,000 feet high and cut up into groups by cross-valleys. These mountains sink abruptly down on the northern side to a narrow strip of coast; their slopes toward the interior are gentler and bare of wood. Similar is the character of the border ranges on the south, the ancient Taurus, only that they are more continuous and higher, having an average elevation of about 7,000 feet and rising to over 10,000 feet in Lycia and Cilicia. The western border is intersected by numerous valleys opening upon the archipelago to the northern part of which Mounts Ida and Olympus belong. Between the highlands and the sea lie the fertile coast lands of the Levant. Of the rivers the largest is the Kizil Irmak (Halys), which, like the Yeshil Irmak (Iris), and the Sakaria (Sangarius), flows into the Black Sea; the Gediz Chai (Hermus) with its affluents the Pactole and Menderes (Mæander), flow into the Ægean.

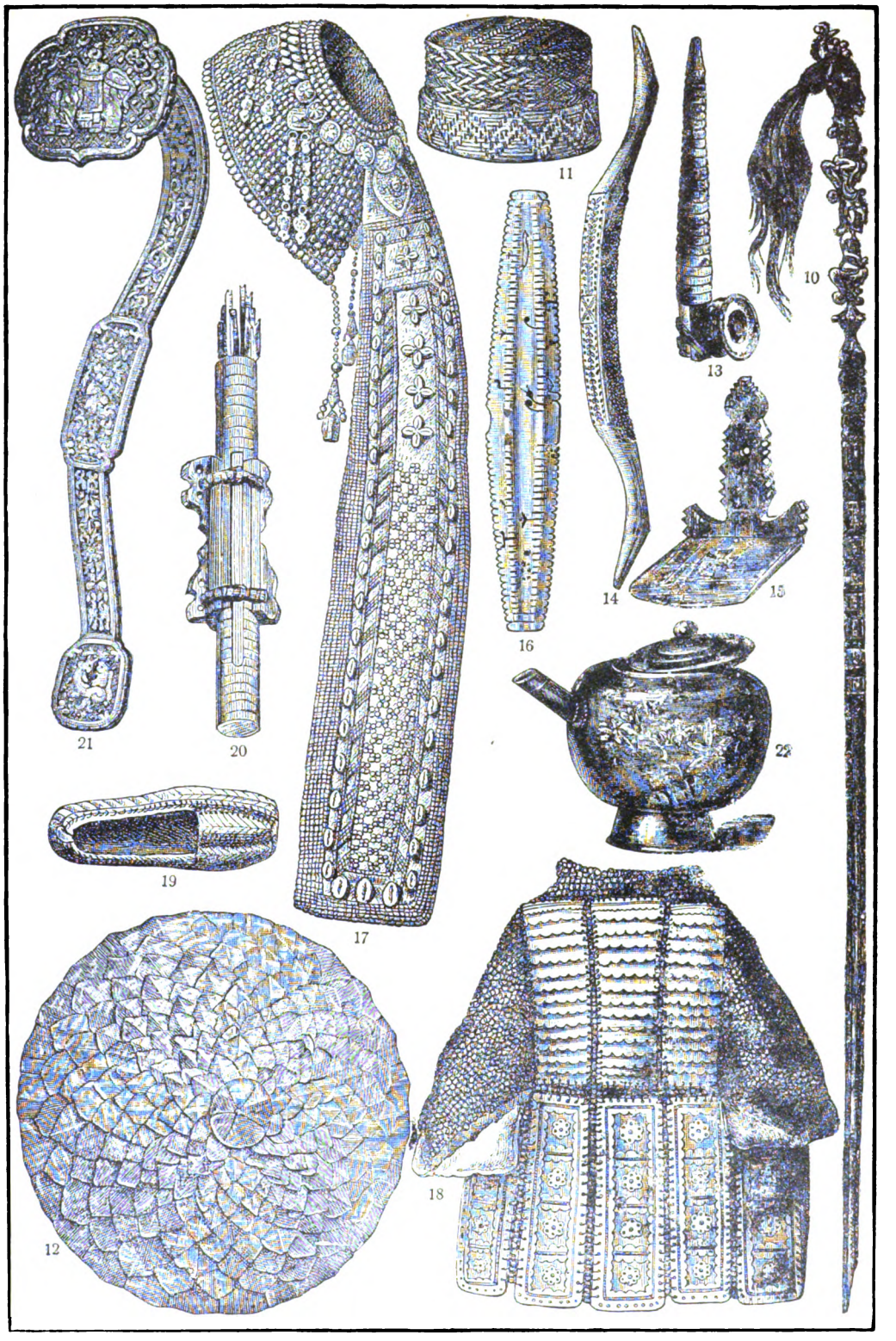
Climate.—The climate has on the whole a southern European character, except on the central plateau which is more Asiatic, and has very little rain, a hot summer and a long, cold winter; the southern coast has mild winters and scorching summers, while on the coast of the Ægean there is the mildest of climates, the summer being tempered by sea breezes and a magnificent vegetation. On the northern side, being exposed to the northeast winds from the Black Sea, the climate is not so mild, but there are abundant rains and the vegetation is luxuriant.

Industrial Development.—In point of natural history Asia Minor partakes of the character of the East and of the West. The forest trees and cultivated plants of Europe are seen mingled with the forms characteristic of Persia and Syria. The central plateau, which is barren, has the character of an Asiatic steppe, more adapted to the raising of flocks and herds than for agriculture, except the cultivation of wheat and other grains; horses, excellent mule-camels and the Angora-goat are bred here. The coasts are rich in all European products, fine fruits, olives, vines and silk have quite the character of the south of Europe, which on the warmer and drier southern coast shades into that of Africa. The chief products besides those mentioned are wheat and other grains, cotton, tobacco, flax, poppy-seed and licorice. Carpets, rugs and silk stuffs are the principal manufactures. Asia Minor has considerable mineral wealth, including lead, copper, petroleum, meerschaum, gold, silver, coal and salt, but it is as yet almost undeveloped. The main exports are figs, raisins and other fruits, olive oil, silk, cocoons, carpets, sponges, mohair, wool, hides, cattle, gum, poultry, wax and tobacco.

The People.—The inhabitants, some 10,000,000 in number, consist of the most various races. The dominant race are the Osmanli Turks, who number about 7,000,000, and are spread over the whole country; they are mainly engaged in agriculture and cattle-raising. Allied to these are the Turkomans and Yuruks, speaking a dialect of the same language. The latter are found chiefly on the tableland, leading a nomadic life; there are also hordes of nomadic Kurds. Among the mountains east of Trebizond are the robber tribes of the Lazes. Before the European War the Greeks and Armenians were the most progressive elements in the population and had most of the trade. While the Greeks monopolized the professions, the ownership of the land was largely passing into the hands of the Greeks, Armenians and Jews.

Administration.—The country falls into eight vilayets or governments with their capitals in Brusa, Smyrna, Konia (Iconium), Adana, Sivas, Angora, Trebizond and Kastamuni, respectively, and the two "independent" Sanjaks of Ismid and Bigha. In ancient times the divisions were Pontus, Paphlagonia, Bithynia in the north; Mysia, Lydia, Caria in the west; Pisidia and Cilicia in the south; Cappadocia in the west; and Galatia with Lycaonia and Phrygia in the centre. The Ægean Islands, which have recently passed

1 Dancing Staff from Sumatra
2 Fetich from Nias
3 Aino Shuttle
4 Bashkir Ornament
5 Bronze Buddha
6 Helmet
7 Gauntlet
8 Japanese Kettle, Silver and Bronze
9 Singhalese Work



10 Dancing Staff from Sumatra
11 Head Covering from Luzon
12 Hat from Borneo
13–16 Articles from Samoa and Tonga Islands
17 Bashkir Ornament
18 Suit of Armor
19 Armored Shoe
20 Aino Quiver
21 Mandarin's Staff in Red Lacquer
22 Japanese Water Bottle

out of the hands of Turkey, belonged most of them to Asia Minor.

Railways.— The right to construct railways in northeastern Asia Minor and Armenia has been conceded to Russia. The earliest roads, however, were constructed by English and French companies in 1856 and 1866, respectively, the first running from Smyrna to Aidin and Dineir with several branch lines; the second from Smyrna to Cassaba with extensions to Afion and Karalussar. The main or Anatolian line was opened about 1873, the first section running from Haidar Pasha to Ismid. In 1888 it was taken over by the German Society of Anatolian Railways, financed by the Bank of Berlin, and in 1892 was extended to Angora, and in 1896 to Konia. In 1902 the German Bank received the concession for the Bagdad Railway (q.v.) by which the Anatolian line was to be extended from Konia to Adana, Mosul, Bagdad and Basra, with numerous branch lines. It has been completed continuously as far as Kara Buna in Cilicia (1911–12) and with the various sections already completed was in 1916 operating along a length of 538 miles from Konia. The total length of railways in Asia Minor is about 1,500 miles and the benefits derived from them by the country are inestimable.

History.— Here, especially in Ionia, was the early seat of Grecian civilization and here were the countries of Phrygia, Lycia, Caria, Paphlagonia, Bithynia, Lydia, Pamphylia, Isauria, Cilicia, Galatia, Cappadocia, etc., with Troy, Ephesus, Smyrna and many other great and famous cities, including the seven churches of the book of Revelation. Here in the dawn of history the non-Aryan race of the Hittites, whose capital is thought to have been at Boghaz Keni, rose to power; here from the obscure era of Semiramis (about 2000 B.C.) to the time of Osman (about 1300 A.D.), the greatest conquerors of the world contended for supremacy; and here took place the wars of the Medes and Persians with the Scythians; of the Greeks with the Persians; of the Romans with Mithridates and the Parthians; of the Arabs, Seljuks, Mongols and Osmanli Turks with the weak Byzantine empire. Here Alexander the Great and the Romans successfully contended for the mastery of the civilized world, and here the Crusaders passed on their way to the Holy Sepulchre. But notwithstanding all these wars the country still continued to enjoy some measure of prosperity till it fell into the hands of the Turks, under whose military despotism its ancient civilization has been sadly brought to ruin. Recently considerable portions of Armenia have been absorbed by Russia. In 1878 Great Britain made a secret engagement to guarantee against Russian aggression the Asiatic dominions of the Porte. Of recent years German influence has been preponderant throughout the Turkish empire and in Asia Minor all the railroads of the plateau are practically in the hands of German capitalists.

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ASIAGO, Italy, town of the province of Vicenza, 17 miles north of the city of that name. It is the capital of the district of Setti Communi; has manufactories of straw hats and has a large percentage of Teutons among its inhabitants who number about 5,500. In the great German drive of November 1917 Asiago and the surrounding plateau were menaced by the Teuton forces. For a detailed account of the military operations in Venetia see WAR, EUROPEAN.

ASIARCH, ā'shī-ärk, a Roman officer appointed as director-general of religious ceremonies in the province of Asia. The expression occurs in the Greek Testament, *Tines de kai tōn Asiarchōn,* "And certain also of the Asiarchs" (Acts xix, 31). Properly speaking there was but one Asiarch residing at Ephesus; the others referred to were his subordinates.

ASIATIC BROTHERS, the designation of a secret society organized in Germany about 1780. See ROSICRUCIANS.

ASIATIC SOCIETIES, learned associations formed for the purpose of collecting and disseminating valuable information respecting the different countries of Asia. The Royal Asiatic Society of Great Britain and Ireland was established 19 March 1823. With it in 1828 was connected a very active translation committee which publishes English, French and Latin translations of Oriental works, occasionally accompanied with the originals. Similar societies have been formed in Asia itself, such as the Asiatic Society of Bengal at Calcutta, founded in 1784 by Sir William Jones. Since 1846 the Bibliotheca Indica,— a series of Oriental works in text and translation,— has been published under the supervision of this society at the expense of the Anglo-Indian government. There are similar societies on the Continent and in America, such as the Société Asiatique at Paris, founded in 1822, the Oriental Society of Germany (Deutsche Morgenländische Gesellschaft), founded in 1845, and the American Oriental Society, organized 7 Sept. 1842, and which in 1915 had a membership of 304.

ASIMINA, ą-sim'i-ną, **Papaw,** a genus of nine species of shrubs or small trees of the family *Anonaceæ,* eight of which are natives of eastern North America, the West Indies and Mexico, with attractive foliage and large purple or whitish axillary flowers appearing in early spring, and large edible fruits. Two species are cultivated for ornament and deserve more attention at the hands of horticulturists. One of these, *A. triloba,* which has produced some varieties, is the only arborescent species of the genus. It is hardy as far north as Massachusetts and produces very large-seeded fruits, often more than three inches long and too

highly aromatic to suit all palates. The other species *A. grandiflora,* is found in Georgia and Florida and is said to produce delicious fruits.

A'SIPHONA'TA, an order of lamellibranchiate, bivalve mollusks, destitute of the siphon or tube through which, in the Siphonata, the water that enters the gills is passed outward. It includes the oysters, the scallop shells, the pearl oyster, the mussels, and in general the most useful and valuable mollusks.

ASIR, Arabia, district lying between lat. 17° 30′ and 21° N. and long. 40° 30′ and 45° E.; bounded north by Hejoz, east by Nejd, south by Yemen and west by the Red Sea. Its length along the coast is about 230 miles and its breadth about 180. The lowland is hot and barren. Kanfuda is the chief port of the district; Marsa, Hali and El Itwad are smaller ports. The mountainous tract has an average altitude of between 6,000 and 7,000 feet, with a temperate climate and regular rainfall, and is fertile and populous. The valleys are well watered and produce excellent crops of cereals and dates. Juniper forests are said to exist on the higher mountains. The inhabitants are a brave and warlike race of mountaineers and aided by the natural strength of the country have hitherto preserved their independence. The Turks have made repeated attempts to conquer Asir, but beyond occupying Kanfuda and one or two points in the interior, they have effected nothing. No part of Arabia would better repay exploration.

ASK, in Scandinavian mythology, the name of the first man created. According to the legend the gods, Odin, Hæner and Loder, found two trees by the seaside, an ash and an elm. From these they created the first man and first woman, Ask and Embla, and gave them the earth as their dwelling place.

ASKABAD, äs'kȧ-bȧd′, Russia, town in central Asia, capital of the Transcaspian province, 345 miles by rail southeast of Krasnovodsk and 594 from Samarkand, situated in a small oasis at the northern foot of the Kopet-dagh range. It has a public library and a technical railway school; also cotton-cleaning works, tanneries, brick-works and a mineral-water factory. The trade is valued at $1,250,000 a year. The population, 2,500 in 1881 when the Russians seized it, is now about 20,000, one-third of whom are Persians, many of them belonging to the Babi sect.

ASKE, Robert, English rebel: d. 1537. He was of an old Yorkshire family. He became an attorney and fellow at Gray's Inn. Little of his personal history is known, except in connection with the insurrection called the "Pilgrimage of Grace," which began in Lincolnshire in October 1536, as an outbreak against the law passed by Parliament suppressing those monasteries whose revenues fell below £200 a year. Other laws were enacted abrogating a number of old holidays and increasing taxes which aroused the indignation of the people. Aske led the uprising in Yorkshire. His army took Lord Dacy and the archbishop of York prisoners, who were then forced to take the oath of the rebels. The monks and nuns were reinstated; the royal herald was not permitted to read the King's proclamation; and announcing his intention of marching to London to declare the grievances of the commons to the sovereign himself, Aske soon had the whole country under his control. A military organization with posts from Newcastle to Hull was established and Hull was provided with cannon. No terms could be agreed upon, and it was decided to fight a battle on 27 October. A heavy rain prevented the consummation of this plan. The King, in the meantime, sent a conciliatory message which Aske prevailed upon his followers to accept. Aske was pardoned, but the King's promises were not considered sufficient and another insurrection broke out in the east. For his efforts in suppressing this, Aske was thanked by the King. However, in spite of the fact that he had done nothing to forfeit the King's favor, he was sent to the Tower of London and sentenced to be hanged. He was paraded back to York and executed there in July. There is a striking inscription on a tower of the church of Aughtor in East Riding by a member of his family to commemorate the year 1536. Consult Gasquet, F. A., 'Henry VIII and the English Monasteries' (1906); 'Letters and Papers of the Reign of Henry VIII' (Vols. XI and XII); *English Historical Review* (Vol. V, pp. 330, 550); 'Chronicle of Henry VIII' (translated by M. A. S. Hume, 1889); Whitaker, 'Richmondshire' (Vol. I, p. 116), containing a pedigree of the Askes; Hall's 'Chronicle', and Wriothesley's 'Chronicle.'

ASKEW, ăs'kū, or **ASCOUGH, Anne,** English religious zealot and martyr: b. Stallingborough 1521; d. Smithfield, 16 July 1546. On the death of her sister she was induced to become the wife of her sister's fiancé, Thomas Kyme, by whom she had two children. She was a staunch Protestant, and upon being denounced by the family priest, her husband, a Catholic, turned her out of his house. She went to London, where she was arrested and charged with heresy, March 1545. On this charge she was acquitted, but persisting still in devotion to her faith, she was again arrested, June 1546, and tortured on the rack, in spite of which she refused to recant. In the following month, 16 July 1546, she was burned at the stake in Smithfield. Consult Bale, J., 'The Lattre Examinacyon of Anne Askew' (Marburg 1547), and Webb, 'An Account of Anne Askew' (London 1865).

ASKHABAD, äs'khȧ-bȧd′, the thriving administrative centre of the Russian province of Transcaspia, situated in the Akhal Tekke oasis, and occupied by Skobeleff in January 1881, after the sack of Geok Tepé. Its distance from Merv is 232 miles, from Herat 388 miles. Pop. about 52,000.

ASKJA, äsk'yȧ, a volcano in the centre of Iceland, first brought into notice by an eruption in 1875. Its crater is 17 miles in circumference, surrounded by a mountain-ring from 500 to 1,000 feet high, the height of the mountain itself being between 4,000 and 5,000 feet.

ASLAUGA'S (ȧ-slow'găz) **KNIGHT,** the title of a romantic tale of mediæval chivalry, by Friedrich, Baron de la Motte-Fouqué. It was published in 1814. The story is told with simplicity and grace, and with it may be compared 'The Fostering of Aslang' in Wm. Morris' 'Earthly Paradise.'

ASMAI, äs'mī, or **ASMAYI**, an Arabic writer, the instructor of Harun-al-Rashid: b. about 740; d. 830. His history of the kings of Arabia and Persia, prior to Islam, is of great value, while his romance of 'Antar' has been called "the Iliad of the desert."

ASMANITE, a variety of silica, occurring in small grains in certain meteoric irons, and now believed to be identical with tridymite (q.v.).

ASMARA, Africa, capital of the Italian colony of Eritrea in northeast Africa. It is built on the Hamasen plateau, at an elevation of 7,800 feet, and is 40 miles southwest of the seaport of Massawa. The town is strongly fortified. The European quarter contains several fine public buildings, including the residence of the governor, club house, barracks and hospital. Fort Baldissera is built on a hill to the southwest and is considered impregnable. It was occupied by the Italians in 1889, and in 1900 the seat of government was transferred thither from Massawa. It is surrounded by rich agricultural lands, cultivated in part by Italian immigrants and is a busy trading centre. A railway from Massawa to Asmara was completed as far as Ghinda in 1904. There are gold mines about six miles to the north which have been partially worked. The population is about 10,000, including the garrison of 300 Italian and some 1,000 native troops. The European civil population numbers over 500; the rest of the inhabitants are chiefly Abyssinians.

ASMODEUS, or **ASMODAI**, in Hebrew mythology, an evil spirit which slew seven husbands of Sara, daughter of Raguel, at Rages. By the direction of the angel Raphael the young Tobias exorcised Asmodeus with the smell of a fish's liver burned on the coals, into the uttermost parts of Egypt, whither he was pursued by Raphael, who bound him, so that thereafter Tobias and Sarah might be undisturbed by him. (Tobit VI, 14; VII, 2). According to the Talmudic legends Asmodeus had divers relations with King Solomon, whom on several occasions he aided, especially in planning and constructing the temple. In many of the legends he is given as the cause of the sins and excesses which besmirched the character of Solomon. Several scholars have identified Asmodeus with Æshma dæva, the demon of wrath, prominent in Mazdaism, the religion of Persia. Consult Jastrow, 'Hebrew and Babylonian Traditions' (New York 1914); Hastings, 'Dictionary of the Bible' (ib., 1910).

ASMODEUS, The Lame Devil ('Le Diable Boiteux'). A novel by Alain Réné Le Sage, first published in 1707, and republished by the author, with many changes and additions, in 1725. It is sometimes known in English as 'Asmodeus,' and sometimes as 'The Devil on Two Sticks,' under which title the first English translation appeared, and was dramatized by Henry Fielding in 1768.

ASMONÆANS, a family of high priests and princes who ruled over the Jews for about 130 years, from 153 B.C. See MACCABEES.

ASMUS, äs'mŭs, **Georg**, German-American poet: b. Giessen, 27 Nov. 1830; d. Bonn, 31 May 1892. He came to the United States to conduct some mining operations in the copper region of Lake Superior; then lived in New York until 1884, when he returned to Europe. Among the German population of the United States he had an enormous success with his 'American Sketch-Booklet' (1875), an epistle in verse, written in Upper Hessian dialect and overflowing with delicious humor. It was followed by 'New American Sketch-Booklet' (1876). He also wrote 'Camp Paradise' (1877), a story, and a collection of miscellaneous poems (1891).

ASNYK, äs'nęk, **Adam**, Polish patriot and poet: b. Kalish, 11 Sept. 1838; d. Cracow, 2 Aug. 1897. He participated in the insurrection of 1863, for which he had to spend some years in exile in Germany. He was author of 'Poezye' (1872-80), and several successful dramas, 'The Jew'; 'Cola Rienzi'; 'The Friends of Job.'

ASOKA (*Jonesia asoca*), an Indian tree, of the natural order *Leguminosæ*, sub-order *Cæsalpineæ*, with a flower showing orange, scarlet and bright yellow tints. It is sacred to the god Siva, and often mentioned in Indian literature.

ASOKA (ą-sō'ką) **VARDHANA**, an Indian sovereign, who reigned 264-227 B.C. over the whole of northern Hindustan. He embraced Buddhism, and forced his subjects also to become converts. Many temples and topes still remaining are attributed to him.

ASOLANDO: Facts and Fancies, the latest volume of poems written by Robert Browning and published on the day of his death, 12 Dec. 1889.

ASOLO, Italy, town of Venetia, in the province of Treviso, about 19 miles northwest of Treviso, and 10 miles east of Bassano. It is well situated on a hill, 690 feet above sea-level. Remains of Roman baths and of a theatre have been discovered. Asolo was the residence of Catherine Cornaro, Queen of Cyprus, after her abdication. Paulus Manutius was born here. Pop. 5,847.

ASOPUS, the name of several rivers in Greece. The most celebrated of this name are those in Achaia and Bœotia.

ASOTUS, one of the characters in 'Cynthia's Revels,' by Jonson. He is a toady to Amorphus.

ASP, a venomous snake. The name as applied in the Bible probably refers to the hooded, or African cobra (*Naja haje*), common in Egypt, and often represented in hieroglyphics. The naja haje is from three to five feet long, and the loose skin on its neck can be dilated into a hood like that of the Indian cobra, but its markings differ. (See COBRA). The asp employed for suicide by Cleopatra was probably the small-horned viper (*Aspis hasselquistii*). The asp of southern Europe is *Vipera aspis*, found from France to the Tyrol and in Italy. See VIPER.

ASPARAGIN, or **ASPARAGINE**, a nitrogenous substance having the formula $C_4H_8N_2O_3$, or $CONH_2.CH_2CH(NH_2).COOH$, occurring in the juice of most plants, and notably in the growing buds of asparagus. It is readily obtained by filtering the plant juice, and evaporating it to a syrupy consistency. The asparagin then separates in the form of trimetric pris-

matic crystals, which are soluble in water and in acids and alkalis, but insoluble in alcohol or ether. Asparagin undoubtedly plays a very important (though yet unknown) part in the chemistry of plants, since it occurs in large amounts in germinating seeds, and wherever growth is actively proceeding.

ASPARAGUS, a genus of about 150 species of mostly tuberous-rooted, climbing, drooping, trailing or erect perennial herbs or shrubs widely distributed in tropical and warm temperate countries, especially in southern Europe and southern Africa, but more or less cultivated for food or ornament in all civilized countries. Some species rival and even excel the most delicate ferns in beauty of habit and foliage, which, botanically considered, consists not of leaves but leaf-like stems. The ornamental species with the exception of *A. verticillatus* (see below), must all be grown in greenhouses, except in southern Florida and southern California, where they may be planted with safety out of doors. They are readily and usually propagated by seeds, but often also by cuttings and by division. Among the best-known ornamental species cultivated in America are the following: *A. asparagoides,* also known as *Myrsiphyllum asparagoides,* the smilax of the florist, is widely grown for decorative purposes, for which its glossy green leaves specially commend it. (For culture, see SMILAX). *A. sprengeri* is a species native in Natal, with long drooping branches, glossy light-green leaves (white in one variety), small white fragrant flowers in small racemes, and little red berries. It is very popular, especially for planting in hanging baskets. *A. plumosus,* a tall climbing species from South Africa with horizontal branches of beautiful form, texture, and color, which qualities are retained for weeks or even months after cutting, is deservedly one of the most popular of decorative plants. It has developed several varieties, some of which, especially the variety *tenuissimus,* are even more popular than the original species. *A. verticillatus,* a hardy species with tufts of hair-like leaves and small red berries, is a native of Persia and Siberia, and climbs to a height of 12 to 15 feet from a woody root-stock. Several other species are cultivated for ornament in America.

Best and most widely known, however, is *A. officinalis,* esculent asparagus, which is also used to some extent as an ornamental plant. It is a perennial herb, native of Europe and Asia, and commonly found growing on sandy loam or sea shores, river banks and among shrubby undergrowth. In a wild state it rarely exceeds a foot in height and a stem diameter of more than one-third of an inch; but in gardens sprouts are sometimes obtained as thick as a man's wrist, and the plants often grow more than four feet tall. For more than 2,000 years it has been cultivated for its succulent young shoots, produced from the thick root-stocks in spring. An excellent method of growing the plant may be epitomized as follows:

The land chosen for the bed should be a rich, friable and warm loam, preferably exposed to the south or east. Manure should be applied without stint before the plants are set, and the preparation of the soil should be deep and thorough. The plants may be home-grown or purchased. One-year-old plants, if sturdy, are preferable to older ones. For home growing a separate nursery bed should be prepared, and the seed previously soaked 24 hours in order to hasten germination, sown in early spring, about two inches apart and one inch deep, at which rate an ounce should be enough for 200 or more feet of drill. Some radish seed of a small early maturing variety should be sown in the same drill, so that the young radish plants, which quickly appear, may mark the position of the rows of the slower-appearing and less-conspicuous asparagus plants. As soon as the radishes are of edible size, or even before, if necessary, they should be pulled and the asparagus plants, then an inch or two tall, left in possession of the ground. Beyond keeping down weeds, destroying pests and thinning the plants to four inches asunder, no further attention is necessary during the first year. In the spring of the second year, if properly managed during the first, the plants should be large enough to be transplanted to the permanent bed. If too small they should be transplanted at least eight inches asunder and grown a second year in a nursery bed. In the permanent bed the plants should stand at least two feet asunder in rows not less than four feet apart. Five or even six feet for the larger growing varieties is much better. Staminate plants are more productive of shoots than pistillate, but are difficult to recognize until the plants flower. The furrows are plowed six inches deep or deeper, the plants set in the bottom, but at first covered with only about two inches of earth. After growth starts the trench is gradually filled by cultivation which must be thorough, both among the plants and between the rows. Not before the second spring after planting in permanent quarters should any shoots be gathered. At the time of planting a liberal dressing of some slowly decomposing fertilizer, such as ground bone, should be given in the drill, and in the spring of each year complete fertilizers should be applied liberally. (See FERTILIZERS). In addition to such applications many growers spread stable manure upon the bed in the autumn after the tops have been removed, a necessary practice to prevent the scattering of the seeds upon the bed. In the spring as soon as the soil can be worked the land is either plowed shallow or cultivated deeply to bury the manure. Since the plants are gross feeders there need be little fear of fertilizing too heavily. Methods of gathering depend somewhat upon whether the stalks are to be blanched or left green. Blanching is done by ridging the soil 13 inches deep above the crowns. Stalks so produced are gathered as soon as the tips appear above the soil; green stalks are cut when about nine inches long, including the base of two or more inches below the surface of the ground. In each case the stalk may be cut with an asparagus knife or preferably snapped near the crown, or at least at the proper depth, if blanched, by plunging the hand down in the loose soil beside the stalk and severing it with the fingers. By the latter method there is less danger of injuring other shoots. All cutting should cease when green peas, grown in the same locality, are ready for the table, because the plants must be given opportunity to store up food for the following

year. The stems are usually sold in bunches of various sizes, the grade depending upon the length and number of stalks in the bunch. The bunch commonly sold is eight and one-half inches long, weighs about two pounds and contains 30 spears. As a rule, the thicker the spear the better. First-class spears are three-quarters of an inch thick or thicker. Every care must be taken in handling to prevent bruising, since a gummy juice collects in the broken cells, and the injured stalks spoil by heating. After washing, the stalks should be dried and kept cool. If to be shipped long distances, their butts should rest in damp sphagnum moss or similar material. In the home garden, where horse cultivation is not practicable, the plants may be set even as close as 18 inches by two feet, but the manuring, cultivation and other care must be increased in order to obtain choice shoots. Each spring the very liberal dressing of manure applied the previous autumn should be forked, not dug, in, and a lavish amount of commercial fertilizer, rich in potash, phosphoric acid and nitrogen, applied. Soap suds may be emptied upon the bed; they have more or less potash in them. Asparagus sometimes is forced in hotbeds, under green-house benches, in cellars, etc., by setting mature crowns (plants) close together and supplying heat and moisture. A large amount of light is not essential. It is also forced in the field by covering the beds with cloth and applying heat by means of portable steam pipes, either in or upon the ground. In the former case the roots are ruined by the process; in the latter, they are not, but should be given one or more years to recuperate. (Consult reports and bulletins of Cornell Experiment Station and of Missouri Experiment Station). Several other species furnish edible shoots; for example, *A. acutifolius, A. albus* and *A. tenuifolius*, all European species. The tubers of *A. lucidus* are eaten in China and Japan, where the species is indigenous. The shoots of *A. scaber*, which resemble those of *A. officialis*, are inedible because bitter.

Enemies.—Asparagus has only two important enemies, and when compared with other general crops, long cultivated, only a few less serious ones. Asparagus rust (*Puccinia asparagi*) has been known for about 100 years, and sometimes does serious damage. In a badly infested field the plants as a whole seem to be maturing very early, their deep green having been replaced by a tawny brown. The stems, examined closely, show a blistered and ruptured skin, beneath which are brown masses of spores or, in late autumn, almost black winter spores. In the spring the «cluster cup» is the form observed. The most effective control is the resin-Bordeaux mixture, made by adding to each 48 gallons of standard Bordeaux mixture two gallons of resin stock solution, made as follows: Heat five pounds of resin and one pint of fish-oil in a kettle until the resin is dissolved. If very hot, allow to cool somewhat. Then slowly stir in one pound of potash lye and heat again till the mixture becomes the color of amber, when five gallons of water must be added. If the potash be added while the resin is too hot, the mixture may ignite. This solution increases the adhesiveness of Bordeaux mixture. (See FUNGICIDE). With the mixture 50 per cent greater yield has been obtained in unfavorable seasons, and 70 per cent in favorable. Growers cutting 800 bunches or more per acre find that thorough spraying each week for four, five or even more weeks pays well. For detailed account of this disease and specific methods of control, consult N. Y. Experiment Station Report (1901). The asparagus beetle (*Crioceris asparagi*), a European insect introduced about 1856, the only seriously injurious insect pest, is about one-quarter of an inch long with black and yellow or red wing-covers. It belongs to the *Chrysomelidæ*. It appears as the adult in spring, and lays eggs on the shoots. In a few days grayish-green grubs appear and gnaw the green parts of the plants. When full grown they burrow in the ground to pupate for a short time. The broods succeed each other at intervals of about a month, if the weather be favorable. Their natural enemies are lady-bird beetles and soldier beetles. The popular remedies are the corralling of chickens, ducks and turkeys in the plantation; cutting all volunteer plants in waste places; cutting new shoots daily; allowing spindling shoots to remain in alternate rows for the insects to deposit their eggs upon and burning the shoots not less often than once a week; dusting with air-slaked lime or road dust while the dew is on; brushing the grubs to the hot ground from the full grown plants, the middle of the day being chosen for this operation; spraying with arsenites, hellebore or other stomach poisons, etc. A case of fight early and fight late! The 12-spotted asparagus beetle (*Crioceris 12-punctatus*), about the same size as its relative just described, but orange red with black dots, has a similar life history, and may be controlled in the same way, but is not yet seriously troublesome, except in a few localities. Several plant bugs, moth larvæ, beetles and aphids also feed upon asparagus, but have not become serious pests. Consult Year-book United States Department of Agriculture (Washington 1896), and Bulletin No. 10 (1898). See INSECTICIDES.

For fuller details of asparagus culture consult Hexamer, 'Asparagus Culture' (1901); Bailey, 'Standard Cyclopedia of Horticulture' (1914). In the latter will also be found specific instruction for the cultivation of ornamental asparagus.

ASPARAGUS-STONE, a variety of apatite, found in Murcia, Spain, in the form of small, transparent, yellowish-green crystals.

ASPASIA, ăs-pā'shĭ-a, a celebrated woman of ancient Greece: b. in Miletus in Ionia, but spending a great part of her life in Athens. Her house was the resort of the most virtuous, learned and distinguished men in Greece. She inspired the strongest and most enduring affection in the heart of Pericles, who had separated from his own wife and united himself to Aspasia as closely as was permitted by the Athenian law, which declared marriage with a foreign woman illegal. When the Athenians were dissatisfied with Pericles, instead of attacking him they persecuted the objects of his particular favor, and accused Aspasia of contempt of the gods. Pericles defended her in the Areopagus, but it required all his influence to procure her acquittal. After his death (B.C. 429) Aspasia is said to have attached herself to a wealthy but obscure cattle-dealer, of the

name of Lysicles, whom she soon made, however, an influential citizen in Athens. She had a son by Pericles, who was legitimated by a special decree of the people.

ASPASIA THE YOUNGER, called MILTO by Plutarch, a native of Phocea. She was at first the wife of Cyrus the Younger, who gave her the name Aspasia (q.v.) after the famous wife of Pericles of Athens, whose name had become synonymous with wit and brilliance. When Cyrus died his brother Artaxerxes, as his successor, claimed Aspasia, according to the Persian custom. With him she lived until Darius was proclaimed his successor, whereupon Darius claimed her as his rightful property, upon which Artaxerxes made her a priestess of the temple. So bitter did Darius become over being thus foiled in his desire that he began planning to murder his father, but the result was that he was himself slain.

ASPECT, a term in astronomy and astrology, denoting the situation of the planets and stars with respect to each other. There are five principal aspects: (1) sextile aspect, when the planets or stars are 60° distant and marked thus, *; (2) the quartile or quadrate, when they are 90° distant, marked □ ; (3) trine, when 120° distant, marked △; (4) opposition, when 180° distant, marked ☍ ; and (5) conjunction, when both are in the same degree, marked ☌. Kepler added eight more. It is to be observed that these aspects, being first introduced by astrologers, were distinguished into *benign, malignant* and *indifferent;* and Kepler's definition of aspect, in consequence, is "Aspect is the angle formed by the rays of two stars meeting on the earth, whereby their good or bad influence is measured." The aspects now in use are conjunction, opposition and quadrature.

ASPEN, trees of the family *Salicaceæ* and genus *Populus,* native of the cooler parts of Europe and Asia, and succeeding best upon moist, gravelly soils. They grow quickly; usually attain a height of 50 to 60 feet, sometimes even 100 feet; have light, small, thin, toothed leaf-blades upon long, slender, flattened petioles which permit the blade to flutter with the least breeze, hence the specific name of the European aspen, *P. tremula,* "tremulous." The wood being white, light, soft, and porous, is not a valuable fuel, but is useful for making charcoal for the manufacture of gunpowder, and for turning, often being employed for making bowls, trays, troughs, and pails. The wood may be made harder and thus rendered useful for interior work in houses by peeling off the bark and allowing the stem to dry before felling it. In places where this tree abounds, and other timber is scarce or expensive, this method of hardening is very useful. The bark is rich in glucoside called salicin and used in leather tanning. In the United States the European tree is best known as an ornamental one, its variety, *pendula,* with graceful, drooping branches, being perhaps the best weeping poplar. The male plants are preferred because of the abundance of their catkins which appear in early spring before the catkins of American species blossom. The American aspen (*Populus tremuloides*), very generally distributed from Alaska to Labrador and southward to Pennsylvania and California, and in the mountains to Mexico, closely resembles the preceding species. Its light-gray branches render it conspicuous in clearings where it is one of the first trees to appear. It is said to attain a height of 100 feet when grown in the forest, but is usually much smaller. This tree, like the following, is widely used in the manufacture of wood pulp. The large-toothed aspen (*Populus grandidentata*) is a large American species found from Nova Scotia to Minnesota and southward to Tennessee. See POPLAR.

ASPEN, Col., city and county-seat of Pitkin County, on the Roaring Fork of Grand River, and the Colorado Midland and the Denver & R. G. railways; 30 miles west of Leadville. It is situated at an altitude of 7,900 feet. Aspen was incorporated in 1881; and has since become the centre of a rich mining section. In the city and vicinity are more than 20 mines, for which there are a number of silver, zinc, and lead ore mills. While the smelting and concentrating of ores is the distinctive industry, the city has several minor factories, and it is also the principal mining trade centre of the Roaring Fork Valley. The government is vested in a mayor, elected every two years, and a council composed of the mayor and four aldermen. Pop. 1,834.

ASPERGES, the ceremony of sprinkling the people with holy water at the beginning of mass in the Catholic Church. The term is derived from the first word in the Psalm which is recited in Latin by the officiating priest.

ASPERN, äs-pèrn, and **ESSLINGEN,** two villages a few miles east of Vienna, on the opposite bank of the Danube, celebrated for the battle fought 21 and 22 May 1809, between the Archduke Charles with 70,000 Austrians and Napoleon with 36,000 French, in which the latter were defeated. After the fall of the capital the Austrian general resolved to suffer a part of the enemy's forces to pass the Danube, and then to surround them with his own army and drive them if possible into the river. Everything depended on the possession of these two villages: Aspern was at first taken by the Austrians, again lost and retaken, till they at length remained masters of it: from Esslingen they were continually repulsed. The battle was renewed on the 22d; the French army being now increased so as at least to equal the Austrians in number. Thousands of lives were sacrificed in vain attempts to capture the villages. Aspern continued to be the stronghold of the Austrians and Esslingen of the French. When the army of Napoleon gave up all hopes of gaining the victory by forcing the centre of the Austrians, Esslingen served to secure their retreat to the island of Lobau. The loss of the Austrians in killed, wounded, etc., was estimated at less than a third of the whole army; that of the French at half. The latter lost on this occasion Marshal Lannes and General St. Hilaire. The Austrians had 4,000 men killed and 16,000 wounded, the French 8,000 killed and 30,000 wounded. By the French the engagement is known as the battle of Essling or Esslingen, but the Austrians style it the battle of Aspern.

ASPHALT. The general term asphalt is applied to the several varieties of hydrocarbons of an asphaltic base which exist in all conditions from the liquid to the solid state. It is more specifically employed to include the purer forms of hard and soft bitumen, such as elaterite, albertite, gilsonite, nigrite, wurtzilite, brea, etc. The term bituminous rock includes sandstones and limestones impregnated with bitumen or asphalt. This rock, usually shipped without previous refining, is used principally for street pavements and is mixed with other ingredients at the place of use.

The importation of asphalt into the United States is chiefly from the island of Trinidad, off the coast of Venezuela, and from Venezuela itself. Bituminous limestones are imported from Neuchâtel and Val de Travers, in Switzerland, from Seyssel in France, and in small quantities from Germany, Italy, Russia, Austria-Hungary, Spain, Turkey in Asia, Great Britain, the United States of Colombia, Canada, the Netherlands, Cuba and Mexico. The total imports from Trinidad and Venezuela in 1916 amounted to 147,383 short tons. The island of Trinidad, one of the British West Indian possessions, is the largest producer of asphalt in the world. The deposits are operated by an American corporation under a concession from the British government, and also, independently, from land not belonging to the Crown, acquired by purchase. The chief source of supply is a lake of pitch. This lake lies 138 feet above the sea-level and has an area of about 114 acres. The supply is partly renewed by a constant flow of soft pitch into the centre of the lake from subterranean sources. The shipments of this lake pitch average over 140,000 tons per year, and the flow into the lake is at the rate of about 20,000 tons per year. The depth of this lake is about 135 feet at the centre. Distinct from the lake pitch is what is known as "land pitch," the overflow in past times of pitch from the lake, and deposits of similar nature. During recent years strenuous efforts have been made to discredit all asphalt mined from properties located outside of Pitch Lake. These efforts seem to have failed, however. Careful analyses of samples of asphalt taken from different parts of Pitch Lake, from deposits outside the lake and from the district of La Brea show that these asphalts are so similar in composition that for practical purposes they may be considered as identical in quality. The samples have a common origin, for the presence of mineral matter in these asphalts cannot be regarded as adventitious, since it is thoroughly incorporated with the bitumen in the same proportion and has the same percentage of composition, as regards the relative proportions of matter soluble in water, in acids and insoluble substances. There is no doubt that the pitch found in the deposits outside the lake has been derived from the lake itself by the subterranean flow of pitch in the viscous condition. It is true there is a difference in the crude materials in these asphalts; one is softer than the other, because of containing more volatile oils. Nature simply began on the asphalt outside the lake; it being more exposed to the rays of the tropical sun, the process of refining it drove those volatile oils off, a necessary accomplishment to make the material fit for paving purposes. It would appear, therefore, that a part of the labor of refining has been done on the land or overflow asphalt which remains to be done with the lake asphalt.

In 1875 the asphalt paving industry was in its infancy in the United States. In 1903 there were about 42,000,000 square yards of asphalt, sheet and block, which has been laid at a cost of about $110,000,000. These pavements are frequently called bituminous pavements, inasmuch as bitumen is the largest constituent of the asphalt, frequently running as high as 9 per cent. Asphalt is manufactured into a cement by mixing it with other forms of bitumen and this cement is in turn used to bind together particles of sand and limestone in the asphalt pavement. No two asphalts are alike. The life of the pavement depends upon the crude bitumen used, the skill in its manufacture into bituminous cement, the proper proportioning and mixing of the cement with the sand and dust and in the selection of the mineral aggregate.

In 1870, Prof. E. J. Smedt, a Belgian chemist, laid the first sheet asphalt pavement in this country, in Newark, N. J. Prior to this date coal tar had been used as the cementing material, but with little satisfaction. In 1876 Congress appointed a commission, consisting of Gens. Horatio G. Wright and Quincey A. Gilmore, of the corps of engineers, and Edward Clark, architect of the capitol, to select the best pavement for Pennsylvania Avenue in Washington. Forty-one proposals for stone, macadam, tar and asphalt pavements were received. The commission selected two and decided to use Neuchâtel rock asphalt and De Smedt's artificial Trinidad mixture, in the proportion of two to three. The artificial Trinidad mixture has been most satisfactory. When it was decided, in 1889, to repave Pennsylvania Avenue in Washington, the entire avenue was relaid with it, and the Neuchâtel was discarded.

Trinidad Pitch Lake has furnished over 85 per cent of the asphalt used in the United States. The liquid asphalt passing through clay saturates it or carries it in suspension and becomes a brown, earthy, non-viscous substance, chemically composed as follows:

Bitumen	47 per cent
Infusorial earth	28 per cent
Water	25 per cent

The water is evaporated in refining and the residue (approximately one-third clay and two-thirds hard asphalt) regains some of its viscosity and requires the admixture of some flux or softening agent to give it the proper consistency for paving operations. Samples taken at 100 and 150 feet deep at the centre of Pitch Lake do not differ in composition from those taken on the surface near the shore, showing the homogeneousness of the entire mass. The surface is in constant motion, and gradually lowers as the asphalt is removed. Refined asphalt is shipped from Trinidad to Mexico, South America and other foreign countries; but, owing to the very high duty on refined asphalt coming into the United States, it is cheaper to refine here.

In 1892 the New York and Bermudez Company began the importation of a very pure and hard asphalt from a deposit in the state of Bermudez, Venezuela. The Bermudez Asphalt

Lake, covering an area of about 1,000 acres, lies about 20 miles from the Gulf of Paria, in a straight line. There are many springs of soft asphalt or maltha, the largest being about seven acres in area. Outside of the springs, where new material is constantly exuding, the surface of the lake is covered with vegetation and trees, which must first be cut off to reach the asphalt. The quality of the asphalt varies from maltha or liquid asphalt exuding from the springs, to a hard glance pitch. The crude Bermudez asphalt contains on an average about 31 per cent of water, which is present as a mixture and not as an emulsion, and about 66 per cent of bitumen. This asphalt is softer and more brittle than Trinidad, but possesses all essential cementitious qualities. In 1912 extensive deposits of asphalt were discovered in Leyte, Philippine Islands, by a ranger of the Insular Bureau of Forestry. The products of these deposits are now being used in paving the streets of Manila and are also being exported to other points in the Orient by a strongly capitalized corporation.

As early as 1879 asphalt found in southern California was laid at an intersection on Market Street, San Francisco, which is the heaviest traveled street in that city. In 1884 the late Jesse Warren reported on these California asphalts, the only indications of which were slight surface exudations of liquid asphalt and large banks of bituminous sandstone (sand saturated with asphalt). In 1895 the Alcatraz Company successfully laid two streets in New York city and acquired a high standing for the California product which was subsequently controlled by the Asphalt Company of America. It has been laid in many eastern cities under the trade name of "Alcatraz," "Standard," "Ventura," etc., and has been uniformly successful when refined, mixed and laid intelligently by men experienced in handling asphalt in all its stages. Shortly after the organization of the Asphalt Company of America beds of very pure, high grade, liquid asphalt were discovered in southern California. This being a nearly pure, viscous bitumen, it does not require a softening agent or flux, nor the admixture of other bituminous material to make it of the proper consistency for paving.

Asphalt deposits have been found in many widely separated areas in the United States, but commercial production is limited to a few localities in six States, whose output for 1916 is shown in the following tables:

	Short tons	Value
California	18,135	$45,102
Kentucky and Texas	37,777	122,984
Oklahoma	15,431	112,555
Utah and Colorado	27,134	642,640
Total	98,477	$923,281

Within the past few years manufactured or oil asphalt has become an increasingly important part of the industry in the United States and in several countries of Europe. In the United States it is manufactured from certain grades of crude petroleum found in Colorado, Louisiana, Oklahoma, Kansas and Illinois. In 1907 the output of this artificial product for the first time exceeded the combined output of the natural varieties by a margin of over 52,000 short tons. Of late years Mexican oil has proved a strong competitor with our domestic materials, the asphalt product of such oils in 1916 amounting to 572,387 short tons, valued at $6,018,851.

In 1914 there were in the United States 44 plants for the manufacture of artificial asphalt. The following table shows the output and value of the artificial product, made from domestic material, since 1909:

	Short Tons	Value
1909	129,594	$1,565,000
1910	161,187	2,225,000
1911	277,192	3,173,000
1912	354,344	3,755,000
1913	436,586	4,531,000
1914	360,683	3,015,000
1915	664,503	4,715,583
1916	688,334	6,178,851

Recent analyses of true Barbados asphalt and of the artificial have given the following results: Specific gravity, natural, 1.0143; artificial, 1.393. Hardness according to Mohs, natural, one to two degrees M.; artificial, two to three degrees M. Hardness according to Breithaupt, natural, one to two degrees B.; artificial, three degrees B. Soluble in petroleum, natural, very easily; artificial, with great difficulty, slowly and incompletely. Soluble in benzine, natural, very easily and completely; artificial, with great difficulty, slowly and incompletely. Soluble in benzol, natural, very easily and completely; artificial, rather easily. Solubility in wax, natural, not known; artificial, in five to six days, leaving an amber-like remainder. The solution in benzine of the Barbados natural asphalt gives a beautiful brownish varnish layer, which dries in about 10 minutes; that of the artificial asphalt, however, does not; therefore, the first is to be preferred for fine varnish.

Uses of Asphalt.— The purest varieties of asphalt are used to a great extent in the manufacture of asphalt varnish. A refined asphalt usually mixed with some petroleum residuum is used for saturating felt; machinery is used in the process, and a paint or varnish of similar composition is usually applied after the asphalt felt is in place. Asphalt felting has an advantage over coal-tar felting in that it is not rendered brittle by heat or with age. Insulating paints are made from extracted bitumens of asphalt admixed with various substances, so as to produce a hard product corresponding to ebonite. The most important application of asphalt is in the paving industry, in which two methods are employed; asphalt block paving, in which blocks of asphalt composition are first manufactured by machinery, and sheet asphalt, in which the asphalt composition is spread and rolled so as to form large continuous sheets. Upward of 3,000,000 square yards of such pavements were laid in the principal cities of the United States in 1916. The consumption of asphalt and asphaltic materials in the United States is rapidly increasing, amounting in 1916 to 1,456,634 short tons — as compared with 1,224,037 short tons in 1915, and 851,699 short tons in 1914. Besides the domestic consumption, the United States manufactured and exported in 1916 asphaltic articles amounting in value to $494,895, in addition to an export of 36,443 tons of crude asphalt; the entire export trade being valued at $1,254,664.

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schweig 1904); Richardson, 'Modern Asphalt Pavement' (New York 1905; 2d ed., 1908); and 'Asphalt Construction for Pavements and Highways' (New York 1913); Eldridge, 'The Asphalt and Bituminous Rock Deposits of the United States' (in 22d annual report of the United States Geological Survey, pt. 1, Washington 1901). See MINERAL PRODUCTION OF THE UNITED STATES.

ASPHALT PAINTING. Asphalt was once largely used in painting, especially in the old Dutch school. It was dissolved in spirits of wine to ensure greater permanence. Because of its unreliability it ceased to be used.

ASPHALTIC COAL, coal-like substances which though they have sometimes been classified as coals, differ from all the true coals in respect to both their geological position and their composition. They do not occur in strata, but occupy cavities and fissures, into which they appear to have flowed when plastic. They have been found in Devonian, Carboniferous and Tertiary rock. The regions in which they are principally mined are Albert County, New Brunswick (albertite), the Uinta Mountains, Utah (gibsonite and uintahite), and Colorado, West Virginia, Texas and Mexico (grahamite). Wurtzilite is found also in Utah. Their chief uses are as a basis for varnishes and as insulators. Consult Blake, 'Uintahite, Albertite, etc.'; 'Transactions' of the American Institute of Mining Engineers (Vol. XVIII, 1890).

ASPHODEL, the name applied to plants of two genera, *Asphodelus* and *Asphodeline*, hardy annual and perennial fleshy-rooted herbs, natives of the Mediterranean region, belonging to the family *Liliaceæ*. *Asphodeline lutea*, king's spear, or yellow asphodel, the true asphodel of the ancients, attains a height of two to four feet, has numerous long (3 to 12 inches) narrow rough-margined leaves which embrace the stem, and in early summer yellow flowers in long racemes (6 to 18 inches), and large persistent membranous bracts. *Asphodelus albus*, branching or white asphodel, which has radical leaves, blossoms about the same time as the preceding species, and produces its white funnel-shaped blossoms in branched clusters. Both species are readily propagated by division and are of easy cultivation in any soil. They thrive fairly well in partial shade, but do better when more or less exposed to the sun. Forms of the last species are cultivated in Algeria and some other countries for the starchy roots which are used to make alcohol. The refuse from this manufacture, together with the leaves and stems, is employed in paper and cardboard-making. Several other related plants are often called asphodel, among which are *Narthecium ossifragum*, bog asphodel, common on European moors; *N. americanum*, American bog asphodel. False asphodel is a name given to several species of *Tolfiedia*. The asphodel of the poets is *Narcissus pseudonarcissus*.

ASPHYXIA, etymologically, pulselessness, but literally a condition of partial or complete loss of consciousness because of defective oxidation of the blood. The symptoms may be developed rapidly or slowly. In sudden occlusion of the air passages, such as caused by a foreign body in the larynx, or compression of the throat as in hanging or strangling, there is usually a quiet period of from 20 to 30 seconds after which respiratory movements, both of inspiration and of expiration, follow. These gradually increase in frequency and depth until in about a minute powerful expiratory convulsions occur; convulsive movements of inspiration are also produced, but these are usually milder in character. A period of exhaustion sets in, the respiratory movements become slower and more irregular, and gradually cease. During this period the face has become pallid and then deeply cyanosed and flushed, the lips blue to purple, and the body temperature, at first increased, gradually diminishes. The blood pressure is at first increased and then falls gradually to zero. Unconsciousness develops about a minute after the occlusion, although there is great individual variation, the sphincters relax and the urine and fæces are passed. There is a loss of muscle-tone, and the reflexes are abolished. In asphyxia both lack of oxygen and increase of carbonic-acid gas in the blood are important factors. Asphyxia may result from an excess of carbonic-acid gas with a normal amount of oxygen, and may be produced, if the amount of oxygen is diminished one-half, with no variation of the carbon dioxide. For treatment, see DROWNING.

ASPHYXIATING GASES. The employment of asphyxiants as special munitions of war in the form of shells or other projectiles, which when set free produce a suffocating and poisonous effect, is not new. From the earliest times the Chinese have employed various devices of this sort, and in their "stink-pot" secured such results. The French made experiments with asphyxiating shot at Brest in 1851. The use of asphyxiating gases has always been discouraged by the more enlightened authorities, both military and civil. The Hague Conference of 1899 strongly condemned their employment. Lyddite shells were used by the British in the Boer War of 1899–1902, and shimose and similar shells, opaque powders, etc., were used by both sides in the Russo-Japanese War. While not strictly asphyxiating they render untenable a larger area of ground than would be accomplished by an ordinary projectile striking in the same place.

In the European War, at the second battle of Ypres, asphyxiating gases were employed with fearful results. The gases not only caused death but also produced great suffering. The men were seized immediately with an intolerable irritation of throat, nose and eyes, violent choking and severe pains in the chest, accompanied by uncontrollable coughing. Many fell and rose no more. The greater part of those who escaped were sick for several days and many of these after apparent recovery succumbed to pulmonary diseases. After the great outcry in the Allied and neutral press against the action of the Germans in using these gases, the German legation in Berne issued a statement claiming that the French had authorized the use of similar gases two months before their use by the Germans. However, it is claimed the gases authorized by the French cause no permanent injury, but merely sufficient discomfort to force the enemy to leave his trenches. The British have also used asphyxiating gases in their campaign in Picardy and Flanders.

ASPIC, (Fr.) a dish consisting of a clear, savory meat jelly containing fowl, game, fish, etc. In the 18th century the name was applied to a cannon throwing a 12-pound shot. In poetry the word is used in the sense of asp (Shakespeare, Tennyson, Browning). The great lavender or spikenard, French *spic,* Italian *spigo,* is frequently termed aspic.

ASPINWALL, William, American physician: b. Brookline, Mass., 23 May 1743; d. 16 April 1823. He studied medicine in Philadelphia, and practised in his native town. He served as surgeon with the Revolutionary army and later became interested in the subject of vaccination and established that preventive in American practice.

ASPINWALL, William H., American constructor of railroads: b. New York city, 16 Dec. 1807; d. 18 Jan. 1875. He was for many years a partner in a large shipping firm in New York, but retiring from it in 1850, turned his attention to building the Panama Railroad, whose eastern terminus of Aspinwall (now Colon) was named in his honor. He was likewise prominent in forming the Pacific Mail Steamship Company.

ASPINWALL, Pa., borough in Allegheny County, three miles northeast of Pittsburgh, of which it is practically a suburb. It is situated on the banks of the Allegheny River and on the Pennsylvania Railroad. The water works and the lighting system are municipally owned. The government is vested in a council of seven, chosen by popular vote. Pop. 2,592.

ASPIRATOR, a surgical instrument used for drawing off pus from ulcerations otherwise inaccessible, somewhat on the order of a syringe. One form of this instrument consists of a hollow needle, with which internal organs may be reached without extensive operation and through which the pus of a tumor may be pumped out. Other forms are used for drawing off air or other gases with the object of creating a vacuum.

ASPIRIN, acetyl-salicylic acid. An unofficinal salicylate, thought to be more efficient than others and to cause less gastric disturbance because it passes through the stomach unchanged and liberates its salicylic acid in the intestine. It is a white powder, soluble in 100 parts of water. It is employed in rheumatism, gout, tonsilitis, pleurisy, chorea, neuralgia and multiple neuritis.

ASPIROZ, ąs-pē'rōth, **Manuel de,** Mexican soldier, statesman and diplomat: b. Puebla, 9 June 1836; d. Washington, D. C., 24 March 1905. He was graduated from the University of Mexico in 1855, was licensed to practise law in 1863, but upon the French invasion entered the army. In the Juarez insurrection of 1863 against Maximilian, he served in the insurgent army with great distinction, rising from 2d lieutenant to colonel. After the fall of Queretaro he was appointed judge-advocate of the military court which sentenced the Emperor to death, thereby incurring the lasting hatred of the imperial house of Austria, of which Maximilian was a member. In 1867 Aspiroz became assistant Secretary of State for Foreign Affairs in the new republic; in 1872 he did much to settle amicably the claims between the United States and Mexico, which dated from the Mexican War in 1845; in 1873–75 was consul at San Francisco; and in 1875 was elected senator from his native province to the Mexican National Congress. In 1881 he left the Senate to become a member of the commission appointed to make treaties with the powers of the world; was law professor in the College of Puebla from 1883 to 1890, when he was again appointed by President Diaz assistant Secretary of State, serving in that capacity until appointed, in 1899, first Mexican Ambassador to the United States, a position he held till his death. In 1900 he was the Mexican representative at The Hague tribunal; was a member of several scientific organizations, a knight commander of the military Order of Our Lord Jesus Christ of Portugal, and had been presented by the Shah of Persia with the decoration of the Order of the Lion and Rising Sun, and by the Dowager Empress of China with the insignia of the Order of the Dragon, in both cases in appreciation of his services in negotiating treaties between their respective countries. He published 'Código de extranjeria de los Estados Unidos Mexicanos' (1876); and 'La libertad civil como base del derecho internacional privado' (1896).

ASPLENIUM, a genus of about 200 species of small ferns of world-wide distribution, belonging to the family *Polypodiaceæ,* characterized by free veins and elongated sori covered by an indusium. Many of the species are very beautiful and are consequently favorites with cultivators whose space is limited. *A. viride, A. adiantum-nigrum, A. trichomanes,* and other species are commonly called spleenwort from their formerly supposed efficacy in internal medicine. The two last-mentioned species also bear the name of maiden-hair, but are not the true maiden-hair fern (*Adiantum*). In the eastern United States a dozen or more species are to be found growing wild, among which the more common are *A. acrostichoides, A. angustifolium* and *A. filix-foemina* which reach a height of from one to four feet. In cultivation, slight shade is almost essential, as is also abundant water at the roots, but the air must not be very moist else the leaves will turn brown. The plants thrive in peaty soil. See FERNS.

ASQUITH, Herbert Henry, English statesman: b. Morley, Yorkshire, 12 Sept. 1852. He was educated at City of London School, and Balliol College, Oxford, of which he was a distinguished student. He was called to the bar of Lincoln's Inn in 1876; early took a high place in his profession, was junior to Sir Charles Russel as counsel for the Irish Nationalists in the Parnell Commission; and in 1890 was made King's Counsel. He supported the Home Rule policy of Mr. Gladstone, and was returned to the House of Commons as member for East Fife in 1886, a constituency he has since continued to represent. In 1892 he was chosen by Mr. Gladstone to move the vote of no-confidence in the Salisbury government, and stepped at once into front rank as Secretary for Home Affairs in the subsequent Liberal administrations between 1892 and 1895. On the defeat of the Liberal government in the latter year he resumed his practice at the bar. In 1894 he married as his second wife Margot Tennant, a daughter of Sir Charles

Tennant, Bart. At the time of the South African War he was attached to the Imperialist wing of the Liberal party as opposed to the pro-Boer section led by Sir Henry Campbell-Bannerman, and consequently for a time lost favor with the majority of the party. He took a leading and indeed dominating part in the fiscal controversies raised by Mr. Chamberlain, and was the principal speaker on the Liberal side in combatting the arguments of the tariff reformers. On the accession of the Liberals to power in 1905 he became Chancellor of the Exchequer, and as such introduced the Old Age Pensions Bill which was subsequently passed into law. During the illness of Sir Henry Campbell-Bannerman he led the House of Commons with so much ability and address that on the death of the Prime Minister he was called upon to succeed him, 8 April 1908. Since then he has emerged from some great controversies with his position and authority strengthened in the country. The rejection by the House of Lords of Mr. Lloyd George's budget of 1909 was followed by two successful appeals to the electorate on the part of Mr. Asquith, and as a result the Parliament Act was passed in 1911, which deals drastically with the powers formerly possessed by the upper House of mutilating and rejecting the measures sent up to it by Liberal governments. Mr. Asquith was for a long time regarded as lukewarm on the question of Irish Home Rule; but a vital stage was passed in that old and much controverted issue when in 1914 he finally passed the Home Rule Bill. The Insurance Act (1912) and the Welsh Disestablishment Act (1914) stand also to the credit of his government. He is a believer in the Gladstonian principle of never dealing with a question until it is fully ripe; but once a resolution is taken, he acts with promptitude, as witness his assumption of the war secretaryship when civil control of the army appeared to be called in question during the crisis of the Ulster dispute. After the outbreak of the European War his cabinet passed through a series of crises, and he was constrained to form a national coalition ministry in May 1915. This coalition cabinet fell in December 1916. Attacks were made on it from all sides but more particularly from the "ginger group," so-called because it wanted the government to inject more ginger into its actions and display more force. Differences also existed between Mr. Asquith and David Lloyd George. These came to a head when Lloyd George demanded a smaller war council which would have power to act independently of the cabinet as a whole. When Asquith refused his assent to this proposal Lloyd George resigned and forced the resignation of Mr. Asquith 5 Dec. 1916, after eight stormy years of domestic and foreign history. Lloyd George succeeded to the premiership 7 Dec. 1916.

ASS (As. *assa*, Goth. *asilus*, Rus. *assyol*, Lat. *asinus*, probably of eastern origin; cf. Heb. *āthōn*, she-ass) or, when domesticated, DONKEY. A member of the family *Equidæ* and usually placed in the genus *Equus*, with the horse, though sometimes made the type of a separate genus *Asinus*. There are at least three species, one Asiatic, and the others African. From the north African species the domesticated ass or donkey has probably descended, although many of its characteristics, particularly its spirit and bearing, are greatly altered. In size, in the short hair and terminal tuft of the tail, and in the fact that only the fore-legs present callosities, the ass resembles the zebra rather than the horse; and although not striped like the zebra, it has a varying tendency to stripes on the legs. The Asiatic ass (*Equus hemionus*) is divided into three local varieties, of which the one found in Persia and Syria must be that which the Old Testament writers used as a type of unhampered wildness. Of the others, the kiang, koulan, or dziggetai of Tibet, is the largest and most strikingly colored. Its height is sometimes four feet at the shoulders. Like all asses, it is pale underneath, but the color above is a dark red with a narrow black stripe along the mane and backbone from head to tail. The third variety, the onager or ghorkhar, like the first, is smaller and paler; sometimes it is even silvery, and its dorsal stripe is broader in proportion than that of the Tibetan ass. It inhabits the plains of northwestern India, Afghanistan and Baluchistan. Unlike the donkey, these wild asses are so extremely swift, enduring and agile that on the plains they cannot be overtaken by a single horseman. In the mountains they are less shy and sometimes voluntarily approach travelers. Wild asses are hunted for sport and it is said of their flesh that, while resembling venison, it has an even finer quality. The asses of the plains migrate to the hills in summer when the plains are dry. See KIANG.

The African ass (*Equus Africanus*) differs widely from the Asiatic, being larger and having a bluish tint rather than a tendency to red. It is sometimes as much as 14 hands high and has the very large ears which characterize the donkey. The dark stripe on the back begins only at the shoulder, but extends from the tail down the withers; the hair of the mane and tail is short, and varies little from that of the body in color. It is found in all the open regions of northeastern Africa, and westward through the Sahara and Sudan. Like the Asiatic ass, it is extremely wild and fleet. A second species of African wild ass (*Equus somalicus*) was found in Somaliland some years ago, which is distinguished by its grayer color and faintness of its stripes; it also has smaller ears and a more flowing mane. Living examples have been kept in London.

The donkey, or domestic ass, was probably first tamed in Egypt, where it was known before the horse, and has always been much used; some of the eastern breeds of the donkey are far larger and finer than those commonly seen in Europe, though in Spain and Italy, where they are more used, they are superior to those of other European countries. In England they are little employed, but in America are kept by stock raisers in the Middle and Southern States for the breeding of mules and hinnies. (See MULE). Their milk is recommended in cases of consumption and dyspepsia and their skins furnish the leather called shagreen, besides an excellent shoe-leather and the covering of drums.

ASS, Feast of The, a mock ceremony observed in northern France in the Middle Ages. It was originally a good-natured

parody on the church service without intentional irreverence, but degenerated into an indecent performance. It was in substance a brief farce in which Balaam's ass appeared before the church altar to prophesy the coming of Christ.

ASSAB, ąs-sāb′, an Italian trading station on the coast of the Red Sea (Eritrea), 40 miles from the Strait of Bab-el-Mandeb. The neighboring district with an area of 243 square miles was sold in 1870 by some Danakil chieftains to an Italian steamship company for a coaling station on the road to India. In 1880 it was taken over by the Italian government, which, since 1884, has improved the harbor and erected a lighthouse. The "commissariat" of Assab has an area of 5,500 square miles and a population of only 3,000.

ASSAI, ąs-sī, a food made from the fruit pulp of various species of Brazilian palms closely allied to the cabbage palm (q.v.) and largely used in the lower Amazon region. A beverage is also made from the pulp by pouring warm water on the fruit and by kneading. It is thick and creamy and purplish in color and has a rather pleasant flavor. The principal species are *Euterpe edulis* and *E. catinga.* The first species grows in tide-flooded swamps, where it may attain a height of 90 feet with a diameter of only four or five inches. It produces upon branched spadices an abundance of small pea-like purple fruit with a thin firm pulp and a hard seed. These fruits are kneaded in warm water to produce the thick purplish assai which is generally eaten with starchy foods. The terminal bud of this species is eaten like that of its close relative, *E. oleracea,* the cabbage palm, and its stems are used as rafters and poles. The other species grow on dry, sandy, upland soils, its smaller quantity of fruit furnishing a sweeter assai.

ASSAL, as-sāl′, a large salt lake in the district of Adal, in eastern Africa, near the coast of the Bay of Tajura. It is nearly 600 feet below the level of the sea. Abyssinian caravans resort to Assal for the purpose of carrying off the salt, thickly encrusted on its shores.

ASSAM, a chief-commissionership of British India, on the northeastern border of Bengal, bounded on the north by the eastern section of the great Himalayan range; on the northeast by the Mishmi Hills, which sweep round the head of the Brahmaputra Valley; on the east by the mountains inhabited by Khamtis, Singphos and various Naga tribes, and by the Burmese frontier where it runs with that of the state of Manipur; on the south by the Chin Hills, the Chittagong Hill Tracts, and the state of Hill Tippera; and on the west by the Bengal districts of Tippera, Mymensingh and Rangpur, the state of Cooch Behar, and Jalpaiguri District. The area of Assam proper is 53,015 square miles, and with the native state of Manipur (8,456 square miles), a total of 61,471 square miles. The territory may be considered as a long series of fertile valleys watered by the Brahmaputra and its tributaries. The valley of the Brahmaputra consists of rich alluvial plains, about 450 miles in length, with an average breadth of about 50 miles, either but little elevated above the flood-level of the river and its feeders, or so low that large extents of them are flooded for three or four days once or twice in the year. The Surma Valley is a flat plain about 125 miles long by 60 miles wide, shut in on three sides by ranges of hills. It is even more subjected to inundations than the plains of the Brahmaputra, but as the Surma and its tributaries have more permanent banks, the shifting is trifling compared with the banks of the Brahmaputra. The range of mountains which separates these two valleys projects at right angles from the Burmese system, and lies almost due east and west. At its western end it attains a height of more than 4,600 feet in the peak of Nokrek, above the station of Tura. Here the hills are broken up into sharply-serrated ridges and deep valleys, all covered with forest. Farther east, in the Shillong peak, they reach a height of 6,450 feet; but this is only the highest point in a table-land of which hardly any part falls much below 6,000 feet. The highest point in Assam is reached in Japvo, on the border of the Naga Hills District, still further eastward. The state of Manipur consists of a fertile valley, covering an area of about 650 square miles, surrounded by ranges of hills.

In Assam are found the valuable teak and sissoo trees, date and sago palms, the areca palm or betel-nut tree, the Indian fig-tree, oak, pine and bamboo. But the article of most commercial importance grown in Assam is tea, for the production of which there were 779 gardens in 1915, with a total area under crop of 383,821 acres, producing 245,385,920 pounds of manufactured tea. The plant was discovered growing in this region in 1821, but it was not till 1838 that the first shipment reached England. Though not regarded as specifically distinct from the Chinese variety, the plant is much larger and more vigorous. Rice covers a large extent of the cultivated soil, occupying nearly 2,000,000 acres. The other crops include maize, pulse, oil-seeds, sugar-cane, hemp, jute, potatoes, etc. The State Forest Department controlled (1915) 4,528 square miles of forest, while the public forest land amounted to 18,218 square miles, a total of 22,746 square miles. In the jungles roam herds of elephants; in the dense and swampy parts of the forests the rhinoceros, tiger and wild buffalo abound; leopards, bears and wild hogs are numerous, as also are jackals, foxes, goats, deer and the venomous cobra. Coal, petroleum, limestone and iron are found, and gold dust is met with in many of the rivers. The climate is characterized by coolness and extreme humidity, the natural result of the great water surface and the extensive forests over which evaporation and condensation proceed, and the close proximity of the hill ranges, on which an excessive precipitation takes place. Its most distinguishing feature is the copious rainfall between March and May, at a time when precipitation over upper India is at its minimum. The year is thus roughly divided into two seasons, the cold season and the rains, the hot season of the rest of India being completely absent. Storms often occur in the spring months, generally accompanied by high winds and heavy local rainfall, but seldom take the form of destructive cyclones. From the beginning of November till the end of February the climate is cool and extremely pleasant, and at no period of the year is the heat excessive. Assam is subject to earth-

quakes. In 1607 hills are said to have been rent asunder and swallowed up; writing in 1837, McCosh reported that, some 20 years before, a village near Goalpara had completely disappeared, leaving a pool of water in its place. Severe shocks were felt at Silchar in 1809 and 1882, and in 1875 some damage was done to houses in Shillong and Gauhati. The greatest seismic disturbance, however, occurred 12 June 1897, when the station of Shillong was razed to the ground and nearly all masonry buildings in Gauhati and Sylhet were completely wrecked, while much damage was done in neighboring towns. Two Europeans and 1,540 natives were killed, the majority by landslips in the hills and by the falling in of river banks in Sylhet. In 1915 there were over 6,000 miles of roads in Assam, besides 2,770 miles of bridle roads, chiefly maintained by the Public Works Department.

The inhabitants are mainly engaged in agriculture. There is no Assamese nation proper, numerous ethnical groups being represented. The total population revealed by the last (1911) census was 7,059,857. Of these, 6,713,635 belonged to Assam proper and 346,222 to Assam state (Manipur), showing an increase over 1901 of 871,757 for Assam and 61,757 for Manipur. The birthrate for 1914 was 32.9 per 1,000; deaths, 24.7 per 1,000. The density of population per square mile was (1911) 127 for Assam and only 41 for Manipur.

Religions.— Hindus, Aryans and Brahmans made up a total of 3,637,828; Sikhs, 750; Jains, 2,398; Buddhists, 10,506; Parsees, 5; Mohammedans, 1,886,528; Christians, 66,430; Animistic, 1,109,187; others, 2; and, curiously enough, only one Jew. Every census has disclosed a deficiency of women, due to the disproportion between the sexes among immigrants. Child-marriage is common among both Hindus and Muslims in the Surma Valley and in Goalpara; but in Assam proper only Brahmans and Ganaks adhere rigidly to this rule, and the lower castes usually defer marriage till the girl is of age. No fewer than 167 different languages are spoken in Assam, the two chief being Bengali and Assamese. There is a large number of languages belonging mostly to the Tibeto-Burman stock, such as Bodo, or plains Kachari, Khasi, Synteng, the various forms of Naga dialects, Garo, Manipuri, Lushai, Mikir, Miri and Kuki. The principal foreign languages are Hindustani, Mundari, Santali, Oriya, Eastern and Western Hindi. The people seem to be contented, good-natured and inclined to indolence; they have few wants beyond what can easily be supplied from their fertile fields, for which they pay but a very small rental. There are two systems of land tenure, the Zamindari, where single proprietors or proprietary brotherhoods possess large estates for definite periods, and the Raiyatwari, where each petty proprietor (ryot) holds his plot directly from the state, usually cultivates his land himself, and has no landlord between himself and the government. The area operated amounted in 1915 to 5,475,901 acres for the Zamidari, and 25,829,673 acres for the Raiyatwari, producing revenues of $371,405 and $2,226,985, respectively.

Education and Justice.— There were 4,635 public educational institutions in 1915, with an attendance of 226,652 scholars and 187 private institutions with an attendance of 7,231 scholars. The expenditure on education for that year was $884,745. The proportion of illiteracy is high, only 32.8 per cent of the boys and 5.9 per cent of the girls attend school in British India. In Assam there were 18 vernacular newspapers published in 1915. The administration of justice is vested in the courts of magistrates, divided into three classes; and the courts of session for criminal cases. The highest judicial authority is the high court of Calcutta, i.e., there is no appeal to the Privy Council in England.

Assam, known in ancient history as Kâmarûpa, formed in the 7th century A.D. a powerful independent kingdom under a Brahman sovereign, but in the 15th century it broke up into 12 separate states, which, in spite of their numerous internal struggles, were generally able to resist the attacks of the powerful Mogul emperors. Late in the 18th century its condition encouraged the Burmese to make the country a dependency of Ava, but the Burmese encroachments on the territory of the East India Company brought about war with the British. In 1826 Assam became a possession of Great Britain under the administration of the lieutenant-governor of Bengal, and in 1874 was created a chief-commissionership. In 1905 Assam was reunited with eastern Bengal, but by proclamation 22 March 1912 the Assam territories were placed under the immediate authority and management of the governor-general (viceroy) of India in Council and formed into a chief-commissionership. The chief-commissioner presides over a legislative council composed of 26 members; 10 being official, 15 unofficial and 1 expert. The revenue 1914–15 amounted to 1,72,39,180 rupees ($5,746,393); the expenditure to 1,44,64,977 rupees ($4,821,659). There are no large towns of importance. Shillong Town (pop. about 9,000), was chosen as the capital in 1874 on account of its salubrity and convenient position between the Brahmaputra and Surma valleys. The district of Sylhet was also separated from eastern Bengal and incorporated with Assam in 1912, thus adding a territory of 5,388 square miles.

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HENRI F. KLEIN.

ASSAS, äs'sä, **Nicolas, Chevalier d',** a French officer, celebrated for an act of patriotism which cost him his life. He was captain in the regiment of Auvergne when the French army was stationed near Gueldres, in 1760, and on 15 October, while engaged in reconnoitering, was taken prisoner by a division of the enemy advancing to surprise the French camp, and threatened with death if a word escaped him. He shouted, «*A moi, Auvergne, voilà les ennemis!*» and was instantly struck down. An annual pension was allowed to his descendants.

ASSASSINATION, a term denoting the murder of any one by surprise or treachery. It is commonly applied to the murder of a public personage by one who aims solely at the death of his victim. In ancient times, assassination

was often even applauded, as in the Scriptural instances of Ehud and Jael, and in the murder of Hipparchus by Harmodius and Aristogeiton; but assassination by fanatics and men devoted to an idea first became prominent in the religious struggles of the 16th and 17th centuries. To this class belong the plots against the life of Queen Elizabeth, and in recent years the political assassinations committed by anarchists, while the succession of assassinations of Roman emperors is but a series of murders prompted by self-interest or revenge. Omitting these last, the following list includes the most important assassinations, arranged in chronological order. Fuller accounts of the persons mentioned will be found under their particular headings:

Philip of Macedon	B.C. 366
Tiberius Gracchus	B.C. 133
Julius Cæsar	Mar. 15, B.C. 44
Hypatia	A.D. 415
Thomas à Becket	Dec. 29, A.D. 1170
Albert I, Emperor of Germany	May 1, 1308
James I of Scotland	Feb. 21, 1437
Alessandro de Medici	Jan. 5, 1537
Cardinal Beaton	May 29, 1546
David Riccio	Mar. 9, 1566
Lord Darnley	Feb. 10, 1567
James, Earl of Murray, Regent of Scotland	Jan. 23, 1570
William of Orange	July 10, 1584
Henry III of France	Aug. 1-2, 1589
Henry IV of France	May 14, 1610
Villiers, Duke of Buckingham	Aug. 23, 1628
Wallenstein	Feb. 25, 1634
Archbishop Sharp	May 3, 1679
Peter III of Russia	July 17, 1762
Gustavus III of Sweden, Mar. 16; d	Mar. 29, 1792
Marat by Charlotte Corday	July 13, 1793
General Kleber at Cairo	June 14, 1800
Paul I, Czar of Russia	Mar. 24, 1801
Spencer Perceval, premier	May 11, 1812
Kotzebue, the dramatist	Mar. 23, 1816
Duc de Berri	Feb. 13, 1820
Charles III, Duke of Parma, Mar. 26; d	Mar. 27, 1854
President Abraham Lincoln, April 14; d	April 15, 1865
Michael, Prince of Servia	June 10, 1868
Marshal Prim, Dec. 28; d	Dec. 30, 1870
Georges Darboy, archbishop of Paris	May 24, 1871
Earl of Mayo, governor-general of India	Feb. 8, 1872
Sultan Abdul-Aziz	June 4, 1876
Alexander II, Czar of Russia	Mar. 13, 1881
President James A. Garfield, July 2; d	Sept. 19, 1881
Lord Frederick Cavendish and T. H. Burke, in Phœnix Row, Dublin	May 6, 1882
Carter Harrison, mayor of Chicago	Oct. 28, 1893
President Sadi Carnot, France	June 24, 1894
Ex-Premier Stefan Stambuloff, Bulgaria, July 15; d	July 18, 1895
Premier Canovas del Castillo, Spain	Aug. 8, 1897
President Juan Idiarte, Uruguay	Aug. 25, 1897
Empress Elizabeth of Austria, in Geneva	Sept. 10, 1898
Pres. José Maria Reyna Barrios, Guatemala	Feb. 18, 1898
Pres. Ulisses Heureaux, Santo Domingo	July 26, 1899
King Humbert of Italy	July 29, 1900
President McKinley, Sept. 6; d	Sept. 14, 1901
Alexander of Servia and wife, Queen Draga	June 11, 1903
Von Plehve, Russian Minister of the Interior	July 28, 1904
Grand Duke Sergius of Russia	Feb. 17, 1905
King Carlos I and son, of Portugal	Feb. 1, 1908
Prince Ito of Japan	Oct. 26, 1909
Premier Stolypin of Russia	Sept. 14, 1911
Prime Minister Canalejas of Spain	Nov. 12, 1912
Nazim Pasha, Turkish Minister of War	Jan. 23, 1913
Pres. Francisco I. Madeiro, of Mexico	Feb. 23, 1913
King George of Greece	Mar. 18, 1913
Archduke Francis Perdinand of Austria-Hungary and wife, Duchess of Hohenberg	June 28, 1914
Jean L. Jaurés, French Socialist leader	July 31, 1914
Pres. Guillaume Sam of Hayti	July 28, 1915

Many attempts at assassination have been unsuccessful. Among the most prominent of these may be named: Against Alexander III of Russia, repeatedly; Alfonso XII of Spain, 1878 and 1879; Amadeus of Spain, 1872; Duc d'Aumale, 1841; Prince Bismarck, 1866 and 1874; Francis Joseph of Austria, 1853; George III of England, 1786 and 1800; George IV (when Regent), 1817; Humbert I of Italy, 1878 and 1897; Isabella II of Spain, 1847, 1852 and 1856; Louis Philippe, six attempts, from 1835 to 1846; Lord Lytton, viceroy of India, 1878; Baron Hardinge, viceroy of India, 1910; Napoleon I, by infernal machine, 1800; Napoleon III, twice in 1855, and Orsini's attempt in 1858; Queen Victoria, 10 June 1840, 30 May 1842, 3 July 1842, 19 May 1849 and 2 March 1882; William I of Germany, 1861, 1875 and twice in 1878; President Diaz of Mexico and President Morales of Brazil, both in 1897; Edward VII as the Prince of Wales in 1900; Alfonso of Spain in 1905, 1906 and 1913. Consult Johnson, 'Famous Assassinations' (Chicago 1903).

ASSASSINS, or **HASHISHEENS,** a term applied to a secret order of religious fanatics who flourished in the 11th and 12th centuries. They derived their name of assassins originally from their immoderate use of hasheesh, which produces an intense cerebral excitement, often amounting to fury. Their founder and lawgiver was Hassan-ben-Sabah, to whom the Orientals gave the name of Sheikh-el-Jobelz, but who was better known in Europe as the "Old Man of the Mountain." Their principal article of belief was that the Holy Ghost was embodied in their chief and that his orders proceeded from the Deity. They believed assassination to be meritorious when sanctioned by his command, and courted danger and death in the execution of his orders. They were frequently styled Ismaili. A feeble residue of the sect, from whom proceeded the Druses, about A.D. 1020, has survived in Persia and Syria. The Syrian Ismaili dwell around Mesiode and on Lebanon. They are under Turkish dominion, with a sheikh of their own, and formerly enjoyed a productive and flourishing agriculture and commerce. Since the war with the Nassarians, 1809–10, they have dragged out a miserable existence, but are commended by modern travelers for their hospitality, frugality, gentleness and piety.

ASSAULT. *In law,* an assault is a movement virtually implying a threat to strike, as when a person raises his hand or his cane in a menacing manner, or strikes at another but misses him. It is not needful to touch one to constitute an assault. When a blow actually takes effect the crime is not simple assault, but assault and battery. Assault, however, is usually coupled with battery and for the reason that they generally go together; but the assault is rather the initiation or offer to commit the act of which the battery is the consummation. An assault is included in every battery. An aggravated assault is one performed with the intention of committing some additional crime, such as an assault with intent to commit rape, assault with intent to murder, an assault with a deadly weapon, an indecent assault. The defenses usually interposed in cases of assault are self-defense, recapture of property, ejectment of trespassers, defense of property, defense of family, accident, etc. A person assaulting another may be prosecuted by him for the civil injury and also be punished by the criminal law for the injury done to the public.

In military language an assault is a furious effect to carry a fortified post, camp or fortress where the assailants do not screen them-

selves by any works. It is the appropriate termination of a siege which has not led to the capitulation of the garrison. To give an assault: To attack any post. To repulse an assault: To cause the assailants to retreat; to beat them back. To carry by assault: To gain a post by storm. In fencing, an assault of (or at) arms is an attack on each other (not in earnest), made by two fencers to exhibit or increase their skill. (Sometimes it is used in a wider sense for other military exercises).

ASSAY OFFICES. See ASSAYING.

ASSAYE, ăs-sī', village in southern India, where Wellington gained a famous victory in 1803. With only 4,500 troops at his disposal he completely routed the Mahratta force of 50,000 men and 100 guns. The victory, however, cost him the loss of more than a third of his men.

ASSAYING, the art of testing ores or alloys for the purpose of determining the amount of some particular metal that is present in the material analyzed. Assays may be made by "wet" or "dry" methods, and will vary greatly in detail, according to the metal to be determined. The present article will be chiefly devoted to the usual process of estimating gold and silver in the "dry" way. The mode of procedure is substantially the same, whether the assay is made upon ore or upon bullion, except as to the method of obtaining the sample to be examined. If the material proposed for the assay is bullion, or any metallic alloy, the sample for examination is obtained by drilling into the specimen in different places, and mixing the borings. In the case of an ore, the usual method of obtaining a sample for assaying is by "quartering." If this is done by hand, every tenth shovelful of the ore to be examined is thrown upon the floor, until a conical heap containing perhaps 10 tons has been accumulated. This heap is next flattened somewhat and divided into four quarters, as nearly equal as possible. Two of the diagonally opposite quarters are thrown back into the main body of ore, and the remaining two quarters are thoroughly mixed, spread out into a second pile and "quartered" again in the same manner. The process is continued (the ore being crushed in the meantime as often as appears necessary) until the original sample has been reduced to from one to three pounds, after which it is ground fine and the specimens desired for examination are made up by random selections from the final pulverized product. More commonly, ores are sampled by mechanical or semi-mechanical methods and the sampling is not done by the miner, but by a "sampling mill," which acts as the agent both of the miner and of the smelting works. In such cases the ore is first shipped to the sampling mill, where it is unloaded, weighed, crushed and passed through a chute in which one quarter is mechanically selected and passed into a separate bin. The quarter thus mechanically reserved is next thoroughly mixed, after which the "cutting down" is commenced. This consists in removing the ore from the floor by means of a specially constructed sampling shovel which catches about half of it, and lets the remainder fall into a barrow. The ore retained by the shovel is thrown into three buckets, in rotation, and the contents of the buckets are then coned up in one pile and divided again in the same manner. The ore is then further crushed, and the process is continued until, finally, three samples, weighing about 10 pounds each, are obtained Part of each of these is sent separately to the assayer, who assays all three. If the results are not adjudged to be sufficiently accordant, the sampler concludes that the mixing was not well done, and the operations described are repeated. But if the three samples agree fairly well, their average is taken as representing the value of the ore; and on this basis the sampler settles with the miner and afterward with the smelter, thus acting as a middle-man in the sale of the ore.

The specimen of ore received by the assayer is ground fine enough to pass through a 60-mesh or a 100-mesh screen, any "metallics" (or particles of metal that will not pass through the screen being carefully collected and reserved for a separate assay). If the ore is new to the assayer, his next step is to examine it microscopically and to apply various preliminary tests so that the general nature of the ore may be known before the quantitative work begins. If assays of the same material have been made before, and the only object is to ascertain the richness of this particular lot of ore, he may proceed directly to the process of "scorification," by which the gold and silver present in the ore are obtained in the form of a metallic button. The scorification process depends for its success upon the fact that when an ore of gold and silver is strongly heated with metallic lead in the presence of air, the baser metals that are present will oxidize and the lead oxide that is also formed will dissolve the silica (or quartz) that is present; while the gold and silver will not oxidize, but will be left in the metallic state, alloyed with that portion of the lead which remains unoxidized. To apply this principle, 50 grains or so of the ore are mixed with some 500 grains of granulated lead and placed in a sort of crucible, called a "scorifier." Another charge of 500 grains of lead is spread evenly over the mass, and a few grains of borax are sprinkled upon the top. The crucible and its contents are next heated for about three-quarters of an hour in a muffle to which a small amount of air is admitted, after which the melted mass in the crucible is poured into a mold to "set," or cool. When the mold is cold it will be found to contain a button of metallic lead (in which the gold and silver originally in the ore are concentrated), and also a considerable amount of slag, consisting of oxide of lead, oxide of the base metals that are present in the ore and silicates of lead, derived from the combination of the melted lead oxide with the quartz of the ore. The slag is readily detached from the metallic button by taps with a hammer.

The next step is to "cupel" the button, so as to obtain the gold and silver in a pure state. Cupellation is based upon the fact that when an alloy of gold, silver, lead, and base metals is heated in a current of air, the lead and the other base metals will oxidize, and the melted lead oxide ("litharge") will retain the other oxides in solution. Moreover, if the crucible in which the operation is carried out is porous, the melted lead oxide will soak into it, carry-

ing the base oxides with it, and leaving a button of pure gold and silver behind.

The "cupel" in which this is performed is made of bone-ash, and after the button left from the scorification process has been heated in the cupel for a short time, the process indicated above takes place, its completion being indicated, to the practiced eye, by play of iridescent colors on the cupelled button. The button is finally allowed to cool, and after it has been taken from the cupel, any small particles of bone-ash that remain adhering to it are removed by a brush.

If the original ore contained no silver, the assay is now completed, and it only remains to weigh the gold button, and compare its weight with that of the sample of ore used in the assay. But if silver is present, one other process, known as "parting," must be carried out, in order to separate the gold from the silver. Parting depends upon the fact that nitric acid will dissolve the silver out of an alloy of silver and gold, *provided* the weight of silver present is at least 2.5 times as great as the weight of the gold. In order to ensure the fulfilment of this necessary condition, the button, as it comes from the cupel, is melted with 2.5 or 3 times its own weight of silver that is known to be free from gold, and the alloy so formed is flattened out into a thin plate or ribbon, which is then rolled up into a little spiral, or "cornet," and boiled in nitric acid. The cornet is next washed in distilled water, and boiled again in nitric acid, to remove the last traces of silver; after which it is thrown into a crucible and melted into a button, for weighing. The button obtained by this final process consists of pure gold.

Assay Offices in the United States are government establishments in which citizens may deposit gold and silver bullion, receiving in return its value, less charges. The offices are in New York city; Boise City, Idaho; Helena, Mont.; Denver, Col.; Seattle, Wash.; San Francisco, Cal.; Charlotte, N. C.; and Saint Louis, Mo.; Carson City, Nev.; Deadwood, S. D.; New Orleans, La.; Philadelphia, Pa.

The assay office in New York was established by law in 1853, and was opened in the autumn of 1854. The first assayer of the New York assay office was Dr. John Torrey of Columbia College, who was appointed in 1854 and held his position till 1873. On his death he was succeeded by his son, Herbert Gray Torrey. Andrew Mason, who was appointed superintendent in 1883, having previously been assistant assayer and melter and refiner. While holding the latter office he substituted the use of sulphuric for nitric acid in the refining process, thus saving this one assay office $100,000 per annum.

The United States assay office is in a building located beside the more imposing subtreasury building, at the intersection of Wall and Broad streets, which marks one of the most historic spots in the country, namely, the site of the old Federal Hall, where Washington took the oath as first President of the United States. Although the building is small, yet it only masks a really large, inner building surrounded on all sides by office buildings and the sub-treasury. The assay offices, and particularly this one, have an important position in the world of finance, for here the precious metals — gold and silver — in all forms and conditions of fineness are assayed and refined. In brief, the work of this office consists in assaying or determining the value of gold and silver, in whatever form presented, as coin, jewelry, or in any other shape. Any one wishing to have gold or silver assayed in quantity or wishing to sell to the government may present his property at the assay office, where he may have the metal reduced and made into bars, or if he prefers, he may sell his bullion to the government. The charge for doing the work is merely nominal, and based on the actual cost. Millions of dollars are stored at all times in the vaults. When the metal is received, the first step consists in weighing the coin, bars, jewelry or tableware. This is done with great exactness and a receipt is given. Each person's holdings are placed in a box and are taken to the melting-room, where they are placed in crucibles with a flux and smelted and cast in ingot molds, the pouring being a highly picturesque operation. A small chip is taken from the bar for assay. See COINAGE.

If the depositor wishes to part with his bullion, the government pays for it at the prevailing price and proceeds to separate or part the gold from the silver. The price of gold never varies, costing $20.67 a fine ounce. Silver fluctuates with the market.

The importance of the assay office in its relation to the financial world, the treasury, and the mint cannot be overestimated. During a recent year 10,739 melts of gold deposits and 1,642 melts of silver deposits were assayed. Fine gold melts numbered 324 and fine silver melts 49. The number of special assays was 850. The total assays was 71,000. Consult Bugbee, E. E., 'Text-book of Fire Assaying' (Boston 1915); Outerbridge, A. E., 'Assaying by the Spectroscope' (Philadelphia 1874); Ricketts, P. de P., 'Assaying and Assay Schemes' (New York 1879); Smith, E. A., 'Sampling and Assay of Precious Metals' (London 1913); Furman, H. v F., 'Manual of Practical Assaying' (New York 1910); Smith, J. R., 'Modern Assaying' (Philadelphia 1910); Fulton, C. H., 'Manual of Fire Assaying' (New York 1911); Lon, A. H., 'Technical Methods of Ore Analysis' (New York 1911); Rhead, E. L., and Sexton, A. H., 'Assaying and Metallurgical Analysis for the Use of Students, Chemists and Assayers' (London 1911); Park, J., 'Text-book of Practical Assaying' (London 1914); Wraight, E. A., 'Assaying in Theory and Practice' (New York 1916); 'Laws of the United States relating to the Annual Assay' (Washington 1880).

ASSEGAI, ăs'sę-gā, a short spear employed as a weapon among the Kaffirs of south Africa. It is made of hard wood tipped with iron, and used for throwing or thrusting.

ASSELIN, as'sĕl'-ăn, **Joseph François Olivar,** Canadian nationalist: b. Saint Hilarion, Quebec province, 9 Nov. 1874. He was educated at Rimouski College, was afterward principal of the evening school at Woonsocket, R. I., and private secretary to Sir Lomer Gouin (1901–03). During the Cuban War he served as a private with the United States troops. Since his return to Canada he has taken a prominent part in the advancement of Nationalist sentiment in his own province, has been associated with La Presse and LeDevoir news-

papers, and in 1904 founded and was for a time editor of *Le Nationaliste*. He is the author of a series of political brochures under the title of 'Feuilles de combat,' and is also author of 'A Quebec View of Canadian Nationalism: an Essay by a Dyed-in-the-Wool French Canadian' (1910).

ASSEMANI, ăs'sę-mä'nę, (1) JOSEPH SIMON, a famous Orientalist: b. of a Maronite family in Tripoli, Syria, 1687; d. Rome, 14 Jan. 1768. He traveled on the Pope's commission through Egypt and Syria, collecting many Oriental manuscripts and coins for the Vatican library, of which he was appointed keeper. Of his numerous learned works, the most important is 'Bibliotheca Orientalis,' issued by order of Clement XI and containing (in manuscript form) the Vatican codices in Syriac, Arabic, Persian, Turkish, Hebrew, Samaritan, Armenian, Ethiopian, Greek, Egyptian, Iberian and Malabaric. (2) STEPHEN EPHODIUS (1707–82), also a learned author of books on Oriental learning. He was titular archbishop of Apomaca, Syria. Yet another nephew and Orientalist was (3) JOSEPH ALOYSIUS (1710–82), professor at Rome. (4) SIMON, a relative of the preceding, b. Tripoli 1752; d. Padua, 8 April 1821. He filled the chair of Oriental languages at Padua. He wrote an important work on ancient coins, 'Museo Cufico Naniano Illustrato' (1787–88).

ASSEMBLAGES, General Theory of. The doctrine variously entitled *Mengenlehre* and *Mannigfaltigkeitslehre* by the Germans, *Théorie des ensembles* by the French, and sometimes referred to in English as the theory or doctrine of manifolds or aggregates or by other analogous designations. Many of its ideas are at least as ancient as historical thought and have figured in important ways in logic, philosophy and mathematics steadily from the earliest times. On the other hand, many of the chief concepts involved in it, its characteristic notions, and their organization into a distinct and self-supporting body of coherent doctrine, may be said to constitute the latest great mathematical creation. Indeed the majority of the founders and builders of the doctrine, including Georg Cantor as easily the first of them all, are still among the living. As mathematics is the most fundamental of the sciences, the theory of assemblages seems destined to be regarded, if it be not already regarded, as the most fundamental branch of mathematics. Viewed in retrospect, it appears as an inevitable product of the modern critical spirit. Already it is seen to underlie and interpenetrate both geometry and analysis. Its connection with mathematical logic is most intimate, often approximating identity with the latter; and even philosophy is surely, if but slowly, beginning to recognize in the theory of manifolds her own most inviting and promising field.

The Notions, Assemblage and Element. — Roughly speaking, any collection of objects or things of whatever kind or kinds is an assemblage. Whitehead and Russell, however, have shown that certain limitations must be imposed on this great generality to avoid the most baffling paradoxes. Each object in the collection is called an element of the assemblage. An assemblage, to be mathematically available, must be defined, or, as usage has it, well-defined, (*wohldefinirt, bien défini*). An assemblage is defined when, by the logical principle of the excluded middle, it can be regarded as intrinsically determined whether an arbitrarily given object is or is not an element of it. Means may or may not be known for making the determination actual or extrinsic. Thus if the elements of the assemblage be completely tabulated the determination can be actually effected by comparing the given object with the elements of the table. Again, if an assemblage, such as that of the endless sequence 1, 2, 3, . . . of integers, be given by a definite law of formation of its elements, the law will generally enable one to determine actually whether any given object, as 5 or ½ or an apple or a sunset, is an element of the assemblage or not. But the possession of means the application of which is in our power is not essential to the notion of defined assemblage. A real * number is called *algebraic* or *transcendental* according as it is or is not a root of an equation of the form, $a_0x^n+a_1x^{n-1}+a_2x^{n-2}+\ldots+a_{n-1}x+a_n=0$, having integral coefficients. Any real number, no matter what its origin or definition, is either algebraic or transcendental; it cannot be both and it cannot be neither. Hence the real algebraic numbers constitute a defined assemblage, and so, too, the transcendentals. Nevertheless no means is known for ascertaining in every case whether a given number is algebraic or not. It was really a great achievement when the transcendental character of the long familiar classical numbers e and π was proved, for e by Hermite in 1874 and for π nine years later by Lindemann. Even the existence of non-algebraic numbers was unknown till it was proved by Liouville in 1851.

Depiction and Correspondence.—Assemblages will be denoted by large and elements by small letters. If, in any way, each element a of A is uniquely associated with an element b of B, A is said to be *depicted* on B. The b's so used are the *pictures* of the a's. If all the b's are thus made pictures, B is also depicted on A and the a's are pictures of the b's. If each a is a picture of a b and reciprocally, so that there is a one-to-one correspondence between them, the depiction is called *similar*. Obviously an assemblage can be depicted either similarly or dissimilarly on itself, generally in more than one way, often in an endless variety of ways.

Chains.— If the elements of A are elements of B, A is part of B. If in this case not all b's are a's, A is a *proper* part of B. Any assemblage is part, but not proper part, of itself. One of the most important ideas connected with that of the depiction of an assemblage on itself is the notion of a *chain*: if A be depicted on itself in any definite way, then any part of A that consists of the pictures thus formed is a chain. The theory of chains, due to Dedekind, has fundamental bearings in logic. See INDUCTION, MATHEMATICAL.

The Concept of Equivalence or Sameness of Power.— If A and B are such that each may be similarly depicted on the other, i.e., if a

*The exigencies of the present undertaking demand the expository use of data drawn from the Theory of the Real Variable (which see) and other theories, although these are themselves branches of assemblage theory.

one-to-one correspondence can be established between the elements of A and those of B, A and B are said to be *equivalent* or to have the *same power* (*Mächtigkeit*), a relation symbolically expressed by writing $A \sim B$ or $B \sim A$. Thus if A denote the assemblage of positive integers and B denote, say, the even positive integers, $A \sim B$, for plainly one may pair 1 with 2, 2 with 4, 3 with 6, and so on. Other ways of pairing A and B in this case will readily occur to the reader.

Distinction of Finite and Infinite.—An assemblage is *infinite* if it has the same power as some proper part of itself. Thus A of the last example is infinite. So, too, is B, for it is easily seen that if $A \backsim B$ and if either A or B is infinite, so is the other. The foregoing definition of infinite is one of the most fruitful of modern concepts. It is due independently to Dedekind and Georg Cantor. A finite assemblage is one which can be exhausted by the removal of its elements one at a time. Sometimes an infinite assemblage is defined to be one that cannot be exhausted or emptied by removing from it one element at a time. It has not been proved that the two definitions are logically equivalent. All apparent proofs of this depend on the questionable axiom of Zermelo (see below). For the purposes of investigation, the former is found to be by far the better instrument. An infinite assemblage is often described as *transfinite*.

Denumerability.— Let A denote the assemblage of positive integers. Any assemblage B such that $B \sim A$ is said to be *denumerable* or to have the power of the denumerable assemblage. As $A \sim A$, A is itself denumerable, and it serves conveniently as the *type* of denumerable assemblages. The domain of such assemblages is exceedingly rich and is replete with surprises. For example, though the rational fractions, that is, fractions having integral terms, are so numerous that between any two of them, however near to each other in value, there is an infinity of others, nevertheless the assemblage of rational fractions including the integers is denumerable. Of this the reader can quickly convince himself by reflecting that there is but a finite number of such fractions of which each has a specified integer n for sum of its terms. Thus, if $n=2$, one has 1 or $\frac{1}{1}$; if $n = 3$, one has $\frac{2}{1}$ and $\frac{1}{2}$; if $n = 4$, $\frac{3}{1}$, $\frac{1}{3}$, $\frac{2}{2}$; and so on. Some are repeated; repetitions may be kept or rejected. Dropping them, the required equivalence is seen in the pairing: (1, 1.) (2, $\frac{2}{1}$), (3, $\frac{3}{1}$); (4, $\frac{4}{1}$), (5, $\frac{5}{1}$), (6, $\frac{6}{1}$); . . . . In ordinary speech one is justified in saying that rational numbers are neither more nor less numerous than the integers or than the odd or the even integers. It is plain that the familiar axiom, the whole is greater than any of its parts, is not valid for infinite assemblages. For finite assemblages it is valid absolutely; whether for others is not known. For another example, consider the algebraic numbers before mentioned. These include the rationals and infinitely many besides. Nevertheless the assemblage of all algebraic numbers is denumerable. The proof is too long to insert here. Yet more astonishing is the theorem that an assemblage composed of all the elements of a denumerable infinity of denumerably infinite assemblages is denumerable.

The Power of the Continuum.— At this stage the query is natural: is every possible assemblage denumerable? The answer is, no. The assemblage of all real numbers, i.e., of all rationals and irrationals, is said to constitute a *continuum*. The assemblage of points of a straight line is a continuum, in particular a *linear* continuum. The last two assemblages are in fact of the same power, but neither is denumerable. This is demonstrated by letting $a_1, a_2, \ldots, a_n, \ldots$ represent *any* denumerable assemblage of real numbers and then proving that between any two arbitrarily assumed numbers α and β there is one number and therefore an infinity of numbers not in the given sequence. From this proposition of Cantor's the existence of transcendental numbers, which had been otherwise previously proved by Liouville, follows as a corollary. Any assemblage equivalent to that of the real numbers or to that of the points of a straight line is said to have the power of the continuum. The assemblage of points of any line-segment however short or, what is the same, the assemblage of numbers between any two numbers however nearly equal, has the power of the continuum. Indeed, either of these assemblages is a continuum. But an assemblage may have the power of the continuum without being a continuum. For example, the assemblage of transcendental numbers, though it is not a continuum, has the power of a continuum. In fact, the assemblage left on suppressing from a continuum any denumerable assemblage of elements is equivalent to the original assemblage. This last is a special case of the proposition: If A be infinite, and if the remainder R on suppressing a denumerable part of A be infinite, then $R \sim A$. As above seen the power of the continuum is higher than that of the denumerable assemblage, but whether it is the *next* higher is an outstanding question. There are higher powers than that of any given power (for there is no assemblage of *all* things), but no assemblage of points has a power higher than that of a continuum. On the contrary, it is one of the most marvelous of known facts that the assemblage of points on a line-segment however short is equivalent to the assemblage of all the points of space, nay, is equivalent to all the points of a space having not merely, like our own, three dimensions, but a denumerable infinity of dimensions.

Limit-points, Dense and Derived Assemblages.— A *neighborhood* or vicinity of a point p is a region *small at will* taken about p. If p be in space, a neighborhood may be a sphere having p as centre; if p be in a plane or in a line, a neighborhood will naturally be a circle or a line-segment. The following discussion, conducted for assemblages of points of a straight line, is readily extensible to other points assemblages. Denote by P any given assemblage of points of a line. If there be a point p, in P or not, such that in any neighborhood of p there is one point (and hence an infinity of points) of P, then p is a *limit-point* of P. If p be in P but not a limit-point, p is an *isolated* point of P. The assemblage of all the limit-points of P is the *first derived* assemblage or derivative $P^{(1)}$ of P. The first derivative of $P^{(1)}$ is the *second* derivative of P, namely, $P^{(2)}$; and so on. If P be finite, its $P^{(1)}$ contains no points, it is *empty*. If P be infinite and in a segment, $P^{(1)}$ contains at least one point — a proposi-

tion of exceeding importance in function theory. If the nth derivative $P^{(n)}$ be empty and the preceding derivative contains one or more points, P is said to be of the *first genus* and nth *species*. If $P^{(n)}$ contain points for every positive integral value of n, P is said to be of *second* genus. Every point of a given derivative of P is a point of each preceding derivative, but P may contain points not in any of its derivatives. If some or all of the points of P are in an interval $(\alpha \ldots \beta)$ and if every sub-interval of the given one contains a point or points of P, P is said to be *dense throughout* the given interval. For example, the assemblage of points whose distances from a fixed point of the line are rational numbers is dense throughout every interval. If P be dense throughout a given interval, so is every derivative; in fact, each derivative in such case contains all points of the interval, and conversely. Hence one might lay down the definition: P is dense throughout an interval when and only when $P^{(1)}$ contains every point of the interval. Obviously, if P is dense throughout an interval, P is of second genus, and so, too, are its derivatives. It follows that if P or one of its derivatives be of first genus, P is not dense in any interval. But it is not true that every P of second genus is dense throughout some interval.

Greatest Common Divisor, Least Common Multiple.—The equation $P \equiv Q$ will signify that the point assemblages P and Q are identical. Two assemblages having no element in common are said to be *without connection*. If P contains all and only the points of the assemblages $P_1, P_2, \ldots$, every two of the latter being without connection, the fact is expressed by writing $P \equiv (P_1, P_2, \ldots)$. A part of P is called a *divisor* of it, and P is a *multiple* of each of its divisors. The symbol, $D(P_1, P_2, \ldots)$, is read *greatest common divisor* of $P_1, P_2, \ldots$ and is the assemblage of their common points. $M(P_1, P_2, \ldots)$ is read *least common multiple* of $P_1, P_2, \ldots$ and is the assemblage of all the different points of the P's, it being understood that the latter have no common point. To express that P is empty, one may write $P \equiv 0$. If and only if P and Q are without connection, $D(P, Q) \equiv 0$. Each derivative of P is a divisor of every preceding derivative. If P is of second genus, then $P^{(1)} \equiv (Q, R)$, where Q is the assemblage of those points of $P^{(1)}$ that are not common to $P^{(1)}, P^{(2)}, \ldots$, and R is the assemblage of those that are common.

Transfinite Derivatives.—R is therefore defined by the equation $R \equiv D(P^{(1)}, P^{(2)} \ldots)$ or by $R \equiv D(P^{(1)}, P^{(2)}, \ldots)$, or by $R \equiv D(P^{(n_1)}, P^{(n_2)}, \ldots)$, where $n_1, n_2, \ldots$ are a denumerably infinite assemblage of increasing positive integers. R is called a derivative of P, but the *order* of the derivative is not expressible by a number of the sequence 1, 2, 3, . . . ; these numbers are finite. The order of the derivative is denoted by the transfinite number ω, and one may write $R \equiv P^{(\omega)}$. The first derivative of $P^{(\omega)}$ is denoted by $P^{(\omega+1)}$ and the nth by $P^{(\omega+n)}$. If $P^{(\omega)}$ have a derivative of transfinite order ω, it is denoted by $P^{(2\omega)}$. Continuation of the process yields $P^{(\omega^2)}$, $P^{(\omega^\omega)} \equiv D(P^{(\omega)}, P^{(\omega^2)}, P^{(\omega^3)}, \ldots)$, $P^{(\omega^{\omega^\omega})}$, and so on endlessly. For any assemblage P of first genus, $P^{(\omega)} \equiv 0$, an equation serving to characterize assemblage of first genus. Assemblages of the second genus are definable for which the derivative of any given transfinite order shall consist of a single specified point.

If $D(P, P^{(1)}) \equiv 0$, P is an assemblage of *isolated* points. From any assemblage P, an assemblage Q of isolated points is obtainable by suppressing from P the assemblage $D(P, P^{(1)})$, and one may write $Q \equiv P - D(P, P^{(1)})$. It is known that if P be an assemblage of isolated points, it is denumerable, though, as above noted, the converse is not true. Also, if $P^{(1)}$ is denumerable, so is P; but not conversely, for, for example, the assemblage of rational fractions is denumerable, while its first derivative is a continuum, namely, the assemblage of real numbers. Again, if P be of second genus, and if $P^{(\alpha)}$, α being finite or transfinite, be denumerable, so, too, is P denumerable. A very remarkable theorem is the following: if P be in any given interval and if $P^{(1)}$ be denumerable, the points of P can be enclosed in a *finite* number of sub-intervals having a sum less than *any* prescribed length.

Perfect Assemblages.—If P and $P^{(1)}$ coincide P is called a *perfect* assemblage; in the contrary case, imperfect. For example, if P is the assemblage of points of the interval from p_1 to p_2, including p_1 and p_2, P is perfect; but if P includes only the points *between* p_1 and p_2, P is imperfect, for clearly $P^{(1)}$ includes p_1 and p_2. The definition just given is Cantor's. Another current definition is that by Jordan: P is perfect if it *includes* $P^{(1)}$. It has been proposed to distinguish the two by describing an assemblage, if perfect in Cantor's sense, as *perfect*, and, if perfect in Jordan's but not in Cantor's sense, as *closed*. It has been proved that if P be closed, the assemblage R which results on suppressing $P^{(1)}$ from P is denumerable. But it is not true that every absolutely perfect assemblage is decomposable into a closed assemblage and a denumerable assemblage. The theory of perfect assemblages, though exceedingly subtle, is far simpler than that of imperfect assemblages. Every derivative of P is relatively perfect. There are absolutely perfect assemblages not dense in any interval.

Measure and Measurable Assemblages.—This subject can best be considered by limiting our discussion to sets of numbers in the interval between 0 and 1. Let P be such a set, and let Q be the complementary set—the set of all numbers between 0 and 1 that are not in P. Suppose that a denumerable number of intervals—i.e., sets of all the numbers between k and $k+\epsilon$, exclusive of these values—have been found, including all the points of P. These intervals have lengths, and these lengths, added in the descending order of magnitude, form a series. If this series is convergent, it has a sum, which we shall call S; if the series diverges, we shall say that S is infinite. S depends in general on the particular choice of intervals containing P. However, S will have either a minimum value or a lower limiting value. This is called $\underline{m}(P)$, or the upper measure of P, and depends on P alone. If $1 - \underline{m}(Q)$—the lower measure of P—is equal to $\underline{m}(P)$, their common value is called $m(P)$, the measure of P. A set which has a measure is said to be measurable. The theory of measurable sets is of the utmost importance in the

modern discussion of integration (see REAL VARIABLE, THEORY OF FUNCTIONS OF). Whether there are sets that are not measurable is unknown; an apparent exemplification of such sets by Van Vleck rests on the precarious axiom of Zermelo. Every limited closed assemblage is measureable.

Improper Infinite and Proper Infinite, or Transfinite.— The ordinary notion of mathematical infinity is that of a finite variable, such as tan a, which can take a finite value greater than any previously specified finite value; and such an equation as $\tan 90° = \infty$ is understood by mathematicians to be a kind of short-hand for saying that, by taking a near enough to 90°, tan a can be made to exceed any preassigned finite number, and it does not mean that ∞ is a value that tan a may assume. Similar illustrations abound. Such a variable as thus remains always finite but may be made *large* at will is sometimes described as an *infinite* (variable) in analogy with the reciprocal notion of *Infinitesimal*, a variable that remains always finite but may be made *small* at will. Such infinites are described by Cantor as *improper* infinites. On the other hand both geometry and analysis have long recognized another sort of infinite, viz., one that is not variable but is *constant*. Such an infinite, for example, is the distance from any finite point of a range (see PROJECTIVE GEOMETRY) to the point common to the range and any parallel range. Another example is the distance from any finite point of the complex plane to an "infinite point" of the plane (see COMPLEX VARIABLE). Such infinites are *proper infinites*. Proper infinites of a very different sort arise in the theory of assemblages. We shall now give an account of their genesis and nature.

Transfinite Cardinal Numbers and their Laws.— Denote by A any assemblage of elements a; symbolically, $A = \{a\}$. On disregarding *both* the *character* of the a's and any and every *order* of their arrangement, a new assemblage, an *orderless* assemblage of *characterless* elements (*units*), arises, called the *power* or *cardinal number* of A and denoted by the symbol $\overline{\overline{A}}$.* Herewith the term *power* (*Mächtigkeit*) is itself defined; *sameness of power* was defined above. Plainly every class has a definite power, or cardinal number. The equation $\overline{\overline{A}} = \overline{\overline{B}}$ means that A and B have the same or equal powers or cardinal numbers. It is easily seen that, when and only when $A \sim B$, $\overline{\overline{A}} = \overline{\overline{B}}$. If $A, B, C, \ldots$ have no common element, the assemblage of all the elements involved will be denoted by $(A, B, C, \ldots)$. If also $A', B', C', \ldots$ have no common element, and if $A \sim A'$, $B \sim B'$, $C \sim C', \ldots$, then $(A, B, C, \ldots) \sim (A', B', C', \ldots)$, and the cardinal numbers of these composite assemblages are equal, or the same.

Notion of Greater and Less Powers or Cardinals.— If A and B are such that A has no part equivalent to B and that B has a part equivalent to A, the cardinal number of A is said to be *less* than that of B, that of B *greater* than that of A; symbolically, $\overline{\overline{A}} < \overline{\overline{B}}$, or $\overline{\overline{B}} > \overline{\overline{A}}$.

*This is not to be taken as a precise logical definition of number, but as a rough visualization of the process which will be found treated in detail under ALGEBRA, DEFINITIONS AND FUNDAMENTAL CONCEPTS.

If α, β, γ are cardinal numbers, and if $\alpha < \beta$, and $\beta < \gamma$, then $\alpha < \gamma$. Any one of the relations $\alpha = \beta$, $\alpha < \beta$, $\alpha > \beta$, excludes the other two. But it does not *follow* that every pair of cardinals α and β must satisfy one of the three relations, and it is not known whether they satisfy one of them. This last proposition belongs to the theory of *well-ordered* assemblages, a term explained at a later stage of this writing.

Addition of Powers or Cardinals.— If α and β be the cardinal numbers of A and B, A and B having no common element, and if γ be the power of (A, B), then $\alpha + \beta = \gamma$. Such is the definition of addition. As a power in an orderless assemblage, $\alpha + \beta = \beta + \alpha$, and, in case of any three powers, $\alpha + (\beta + \gamma) = (\alpha + \beta) + \gamma$; that is, addition of powers is *commutative* and *associative*.

Multiplication.— Let $A = \{a\}$ and $B = \{b\}$. Associate each a with each b. Consider each pair (a, b) as an element. The assemblage of these is denoted by $(A.B)$. Hence $(A.B) = \{(a, b)\}$. The power γ of this last obviously depends only on the powers a and b of A and B. Hence the definition of *product*: $\alpha \cdot \beta = \gamma$. As the power, or cardinal number, of an assemblage is orderless, it is readily seen that $\alpha \cdot \beta = \beta \cdot \alpha$ and that, for any three powers, $\alpha \cdot (\beta \cdot \gamma) = (\alpha \cdot \beta) \cdot \gamma$, $\alpha \cdot (\beta + \gamma) = \alpha \cdot \beta + \alpha \cdot \gamma$; that is, multiplication of powers is *commutative*, *associative* and *distributive*.

Involution.— If with each a of A a b of B be associated, any a and the associate b will be a *pair*. The same b may enter two or more pairs. The assemblage of all the pairs resulting from any such definite association is called a *covering* of A with B, and is denoted by $f(A)$. A different covering results if with any a there be associated a b not associated with it before. The assemblage of all possible coverings of A with B is denoted by $(B|A)$; then $(B|A) = \{f(A)\}$. The power γ of $(B|A)$ depends only on the powers α and β of A and B; hence the *definition*: $\alpha^\beta = \gamma$. It may be proved that, if α, β, γ denote any three powers, $\alpha^\beta \cdot \alpha^\gamma = \alpha^{\beta + \gamma}$ $\alpha^\gamma \cdot \beta^\gamma = (\alpha \cdot \beta)^\gamma$, and $(\alpha^\beta)^\gamma = \alpha^{\beta \cdot \gamma}$.

It is an interesting fact that by means of the foregoing definitions of power, and addition, multiplication and involution of powers, the definition and the fundamental properties of the ordinary (finite) cardinals 1, 2, 3, . . . , , . . . can be rigorously deduced.

The Smallest Transfinite Cardinal.— The cardinal number of the assemblage $\{\nu\}$ of finite cardinals is denoted by $\aleph_0$, alef-null. Symbolically, $\aleph_0 = \overline{\overline{\{\nu\}}}$. The transfinite number $\aleph_0$ has the properties: $\aleph_0 + 1 = \aleph_0$; $\aleph_0 > \mu$ where μ is any finite cardinal; $\aleph_0 < a$, where a is any transfinite cardinal different from $\aleph_0$; $\aleph_0 + \aleph_0 = \aleph_0$; $\nu \cdot \aleph_0 = \aleph_0 \cdot \nu = \aleph_0$, where ν is any finite cardinal; $\aleph_0 \cdot \aleph_0 = \aleph_0$; $\aleph_0^\nu = \aleph_0$; etc. It is one of the interesting facts met with in the doctrine of transfinite assemblages that the cardinal number of the points of space or other continuum is precisely $2^{\aleph_0}$.

Simply Ordered Assemblages, Order-types.— A is *simply ordered* when and only when its elements a are so disposed that of every pair a_1, a_2 of them, one, as a_1, precedes, i. e., has *lower rank* and the other, as a_2, comes *after*, i.e., has *higher rank*, and of every

triplet a_1, a_2, a_3, a_4 is lower than a_3 if a_1 is lower than a_2 and a_2 is lower than a_3. To say symbolically that a_1 is lower in rank than a_2 and that a_2 is higher than a_1, we write either $a_1 \} a_2$ or $a_2 \{ a_1$. A simply ordered assemblage that is further so arranged that it has an element of *lowest* rank, a *first* element, and that every part of it has a first element, is said to be *well-ordered*. For example, the assemblage of rational fractions greater than zero and less than one, if arranged in natural order, so that the larger the fraction the higher its rank, is simply ordered but not well-ordered. The same assemblage can, however, be well-ordered, thus: $\frac{1}{2}, \frac{1}{3}, \frac{2}{3}, \frac{1}{4}, \frac{2}{4}, \frac{3}{4}, \frac{1}{5}, \frac{2}{5}, \ldots$, where the scheme is that $\frac{p_1}{q_1}$ shall have lower rank than $\frac{p_2}{q_2}$ when $p_1 + q_1$ is less than $p_2 + q_2$, and if $p_1 + q_1 = p_2 + q_2$, then the fraction having the smaller number for its numerator shall have the lower rank.

If A be a simply ordered assemblage, the new assemblage obtained by abstracting from the character of the elements of A is called the *order-type* of A and is denoted by $\overline{A}$. Obviously, $\overline{A}$ is simply ordered. If A and B are simply ordered, and if their elements can be paired in one-to-one fashion so that the *rank* relation of every two elements a_1 and a_2 of A shall be the same as the rank relation of their correspondents b_1 and b_2 in B, then A and B are said to be *similar*, and to be *depictable* on one another. These definitions of similar and depictable, it is noteworthy, are more restricted than that above given. The similarity of two similar simply ordered assemblages A and B is expressed by writing $A \simeq B$. If A is simply ordered, $A \simeq A$, and if B and C are simply ordered, and if $A \simeq C$ and $B \simeq C$, then $A \simeq B$. It is plain, too, that either of the relations, $\overline{A} = \overline{B}$, $A \simeq B$, implies the other. The definition of similarity given here is analogous to that of sameness of power in an earlier paragraph and can be rendered precise in the same manner.

To every order-type, or ordinal number, corresponds a power, or cardinal number. Thus to $\overline{A}$ corresponds $\overline{\overline{A}}$. The distinction of ordinal and cardinal is of no importance for finite assemblages, but is absolutely indispensable in the doctrine of transfinites. All order-types corresponding to a finite cardinal a are similar, but those corresponding to a transfinite cardinal present a countless variety and are said to constitute a *type-class* $[a]$. To every transfinite cardinal corresponds such a type-class. Any type-class is itself an assemblage, namely, of order-types, and as such has its own cardinal number, which may be shown to be greater than that of each of the order-types involved.

Addition and Multiplication of Order-types.— If A and B are simply ordered, it will be understood that in their union (A, B) the elements of A have the same rank relation as in A, that the like is true of B, and that every a is of lower rank than every b. Hence (A, B) is simply ordered. If A' and B' are simply ordered and if $A \simeq A'$ and $B \simeq B'$, then $(A, B) \simeq (A', B')$. Hence the order-type of (A, B) depends only on $\alpha = \overline{A}$ and $\beta = \overline{B}$. Hence the definition of addition: $\alpha + \beta = \overline{(A, B)}$. Here α is the *augend* and β the *addend*. If α, β, γ be any three types, $\alpha + (\beta + \gamma) = (\alpha + \beta) + \gamma$; *i.e.*, addition of ordinals is associative; but, unlike cardinals, ordinals do not in general obey the *commutative* law. For example, if $\omega = \overline{E}$, where E denotes $e_1, e_2, \ldots, e_\nu, \ldots [e_\nu \{ e_{\nu+1}]$, and if f be any new element, then $1 + \omega$ does not equal $\omega + 1$, for (f, E) and (E, f) are not similar, the latter having a *last* element, while the former has not.

Next from the simply ordered assemblages A and B, form the assemblage S by replacing each b by an assemblage $A_b \simeq A$. It is easily seen that the order-type of S depends only on $\alpha = \overline{A}$ and $\beta = \overline{B}$. Hence the definition of multiplication: $\alpha \cdot \beta = \overline{S}$. Here α is multiplicand and β is multiplier. It is readily proved, in respect to three types α, β, γ, that $(\alpha \cdot \beta) \cdot \gamma = \alpha \cdot (\beta \cdot \gamma)$ and that $\alpha \cdot (\beta + \gamma) = \alpha \cdot \beta + \alpha \cdot \gamma$. That is, multiplication of ordinals like that of cardinals is *associative* and *distributive*. But in general ordinals do *not* obey, while cardinals always obey, the *commutative* law. The reader can easily convince himself that, for example, $\omega \cdot 2 \neq 2 \cdot \omega$. ω^2 is defined as $\omega + \omega \cdot 2 + \omega \cdot 3 + \ldots$, and such order-types as ω^{ω^2}, ω^{ω^ω}, etc., are defined by analogous chains of additions.

Order-type of Rationals.— Denote by R the rational numbers less than 1 and greater than zero, taken in *natural* order. Let $\eta = \overline{R}$. Obviously η belongs to the type-class $\aleph_0$, for we have seen that R is denumerable. Moreover, R is *dense* (contains an element between every two elements) and has no element of *lowest* rank and none of *highest*. By these three properties, R is completely characterized; that means that if A is simply ordered, dense, denumerable, and has neither lowest nor highest element, A and R are similar, and $\eta = \overline{A}$. It follows that $\eta + \eta = \eta$, $\eta \cdot \eta = \eta$, $(1 + \eta)\eta = \eta$, $(\eta + 1)\eta = \eta$, $(1 + \eta + 1)\eta = \eta$, but, $\eta + 1 \neq 1 + \eta$, and, though $\eta + 1 + \eta = \eta$, $\eta + \nu + \eta \neq \eta$, if $\nu > 1$.

Order-type of Linear Continuum.— Denote by θ the order-type of the linear continuum $X = \{x\}$, where $0 < x < 1$, and where X is disposed in natural order, i.e., so that if x and x' be any two elements of X, $x \{ x'$, when and only when $x < x'$. Now X is dense and perfect. It also contains R in such way that in respect to rank there are elements of R between every pair of x's. So is suggested the following fundamental theorem, which serves to characterize the type of the linear continuum completely: *If a simply ordered assemblage A is perfect and if it contains a denumerable assemblage P such that in respect to rank P has elements between every two elements of A, then $\theta = A$.*

Zermelo's Axiom.— In 1904, Zermelo pointed out that a certain principle, which amounts to the statement that given an assemblage A of assemblages B, there exists an assemblage C containing just one member from every B, was being tacitly employed throughout the theory of assemblages. Zermelo considered this axiomatic, but as soon as it was

rendered explicit, most of the mathematicians who had formerly unconsciously employed it disowned it, and set themselves the task of freeing the theory of assemblages from all taint of it. In general, this work has been very successful, but there are a group of outstanding propositions which have not been proved except on the basis of Zermelo's axiom, some of which actually imply it. Among there are (1) that of two unequal transfinite cardinal numbers, one is always the greater; (2) that every assemblage can be well-ordered; (3) that every number is either finite or infinite (in the senses already defined). The conscientious mathematician, when he employs this principle, will always make clear the fact of this employment explicit. See also ALGEBRA, DEFINITIONS AND FUNDAMENTAL CONCEPTS.

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ASSEMBLY, Colonial. See COLONIAL GOVERNMENT, PROPRIETARY.

ASSEMBLY, Constituent. See ASSEMBLY, NATIONAL.

ASSEMBLY, General, the name applied to the highest ecclesiastical court of the Established Church of Scotland. It consists of delegates from every presbytery, university and royal burgh in Scotland, holds meetings annually, in the month of May, and usually continues to sit for 12 days. In its judicial capacity and as the court of last resort, the General Assembly has a right to determine finally every question brought from the inferior courts, by reference, complaint or appeal. The laws enacted by the assembly, after receiving the sanction of a majority of presbyteries, are the established and permanent statutes of the Church, by which everything belonging to the ecclesiastical state, or to the Church courts, is authoritatively regulated. The United Free Church of Scotland has a General Assembly similar in its constitution and functions to that of the Established Church, and the same is true of the Presbyterian churches (q.v.) of Ireland and America. See GENERAL ASSEMBLY OF THE PRESBYTERIAN CHURCH.

ASSEMBLY, Legislative. The legislative assembly of a State, sometimes called the General Assembly or State Legislature, is the body of representatives elected by the people to enact laws for the State, corresponding to the Congress of the United States which enacts laws for the nation. It is composed of upper and lower houses, the members of the former (the senate) usually being elected for a longer term than the members of the latter (sometimes called the assembly, the house of representatives or the house of delegates). While the Constitution of the United States (Art. I, Sec. X) limits the powers of the legislative assembly, its principal powers and limitations are defined in the State Constitutions. The course of legislation varies in the several States, but in general follows the practices of the national Congress, the enacting clauses usually reading, "Be it enacted by the people of the State." Consult Hart, A. B., 'Actual Government' (New York 1903).

ASSEMBLY, National, a body established in France in 1789, and also known as Constituent Assembly. Upon the convocation of the States-General by Louis XVI, the privileged nobles and clergy refused to deliberate in the same chamber with the commons, or *tiers-état* (third estate). The latter, therefore, on the proposition of the Abbé Siéyès, constituted themselves an *Assemblée Nationale,* with legislative powers, 17 June 1789. They bound themselves by oath not to separate until they had furnished France with a constitution, and the court was compelled to give its assent. In the 3,250 degrees passed by the assembly were laid the foundations of a new epoch, and having accomplished this task, it dissolved itself 30 Sept. 1791. The term is also applied to a joint meeting of the Senate and Corps Legislatif, for the purpose of electing a chief magistrate or the transaction of other extraordinary business. Consult Stephens, 'History of the French Revolution' (1886–91); Doniol, 'La Révolution et la Féodalité' (1874).

ASSEMBLY, Right of. The first amendment to the Constitution of the United States provides that "Congress shall make no law abridging the right of the people peaceably to assemble and to petition the government for a redress of grievances." This guaranty is contained also in the various State Constitutions, but it cannot be understood to limit assemblages which have for their object the petitioning of government for a redress of grievances. Unless the public peace, security or welfare be endangered by the exercise of the right to assemble, this guaranty against legislative prohibition would extend protection to assemblies for social, religious or political purposes, but if the assembly be conducted in such a manner as to result in public inconvenience, or if the right to assemble be used to promote unlawful purposes, the right may be restricted. The amendment to the national Constitution is a limitation only on the powers of the national government. These constitutional provisions, however, do not protect the right of assembly against arbitrary interference of administrative or judicial officials. Such interference, of course, is illegal and the injured party has remedy in an action at law for damages or a criminal proceeding under Federal or State

statutes. Theoretically the constitutional provisions are adequate to protect the right of assembly, but in practice they have not always been found sufficient to prevent occasional infringement. The unauthorized and often indiscreet use of the powers conferred upon or possessed by administrative or judicial officials constitutes the chief danger to the due exercise of the right.

ASSEMBLY DISTRICT. See DISTRICT.

ASSEMBLY OF DIVINES, a celebrated assembly appointed by the Long Parliament, and held at Westminster to determine upon the doctrine and liturgy of the English Church. By an ordinance passed 12 June 1643, 121 clergymen, with 10 Lords and 20 Commoners as lay assessors, were nominated as constituents of the assembly. The assembly began its sittings in July 1643, in Westminster Abbey, but in the meantime a royal proclamation had been issued forbidding the assembly to meet, which had the effect of inducing the greater part of the Episcopal members to absent themselves. The majority of those who remained were Presbyterians, but there was a strong minority of independents. A deputation was now sent along with commissioners from the English Parliament to the General Assembly of the Scottish Church and the Scottish Convention of Estates, soliciting their co-operation in the proceedings of the Westminster Assembly, and in September four Scotch clergymen, with two laymen, were admitted to seats and votes. The assembly continued to hold its sittings till February 1649. Among the results of its deliberations were the Directory of Public Worship, the Confession of Faith, and the Larger and Shorter Catechisms, which remain practically the standards of the Presbyterians to the present day. At the Restoration the whole proceedings of the Westminster Assembly were annulled as invalid. Consult Hethorington, 'History of the Westminster Assembly' (1843); Masson, 'Life of Milton' (1858–79).

AS'SEN, ä'sĕn, Holland, the capital of the province of Drenthe. Near it are the Giants' Caves, to which Tacitus makes allusion. Pop. 11,191.

ASSENT, *in law,* an undertaking to do something in compliance with a request. Approval of something done. Express assent is that which is openly declared. Implied assent is that which is presumed by law. Assent must be to the same thing in the same sense. It must embrace the whole of the proposition, must be exactly equal to its extent and provisions, and must not qualify them by any new matter. Unless express dissent is shown, acceptance of what it is for a person's benefit to take, is presumed, as in the case of a conveyance of land.

The Royal Assent is the approbation given by the sovereign in Parliament to a bill which has passed both houses, after which it becomes a law. It may be given in person, when the sovereign comes to the House of Peers and the assent (in Norman French) is declared by the clerk of Parliament; or may be declared by letters patent under the great seal, signed by the sovereign.

ASSER, ä'sér, **Tobias Michael Carel,** Dutch educator and an authority on international law: b. Amsterdam 1838; d. 1913. He was professor of law, first in the Athenæum of Amsterdam, then, after 1876, in the University of Amsterdam. In 1875 he became counsellor to the Dutch Foreign Office and in 1893 member of the Council of State. In 1899 he represented Holland at The Hague Peace Conference and again at the International Court of Arbitration in 1900. In 1911 he was awarded the Nobel peace prize. His works include 'Schets van het Nederlandsche Handelsregt' (1899); 'Schets van het International Privatsregt' (1899); 'La codification du droit international privé' (1901); 'Arbitrage international entre les Etats-Unis d'Amérique et la Russie' (1902).

ASSESSMENT is the determining of the value of a man's property or occupation for the purpose of levying a tax. Determining the share of a tax to be paid by each individual. Laying a tax. Adjusting the shares of a contribution by several toward a common beneficial object according to the benefit received. Assessment of damages includes fixing the amount of damages to which the prevailing party in a suit is entitled. It may be done by the court through its proper officer, the clerk or prothonotary, where the assessment is a mere matter of calculation, but must be done by a jury in other cases. Insurance assessment is an apportionment made in general average upon the various articles and interests at risk, according to their value at the time and place of being in safety for contribution for damage and sacrifices purposely made, and expenses incurred for escape from impending common peril. An assessment is also made upon premium-notes given by the members of mutual fire insurance companies, constituting their capital, and being a substitute for the investment of the paid-up stock of a stock company, the liability to such assessments being regulated by the charter and by-laws, 12 N. Y. 477; 14 Barb. (N. Y.) 374.

Special assessments, or betterment taxes, are charges for improvements which are considered to bring a special benefit upon a piece of real estate over and above the benefit derived from the community at large. Such assessments are levied only on property and are not a personal liability of the taxpayer. Opening of new streets, construction of pavements, sewers and sanitary improvements are the most important objects for which special assessments are levied.

The term assessment is applied also to contributions levied by party committees upon the holders of appointive offices in the civil service. Party committees also make assessments upon candidates for elective offices. This system is noticeable in American political life as early as 1840. It was, however, always looked upon as an abuse but it was not abated until Congress had passed laws making the solicitation of funds from public officers a criminal offense. It has persisted to a limited extent in spite of hostile legislation. Recent legislation in many States requiring the publicity of all political expenditures, and the gradual extension of the "merit system" have greatly diminished the abuse. Consult Brooks, R. C., 'Corruption in American Politics and Life' (1910) and Jenks, J. W., 'Money in Practical Politics' (in *Century Magazine,* XLIV, 1892).

ASSESSOR, (1) one who advises or assists. Both in Great Britain and the United States nautical assessors are called in to advise and assist the courts in the administration of admiralty cases on difficult questions of navigation. Assessors are also called into various other courts, as the court of appeals or county courts, in Great Britain to act in an advisory capacity. By Federal statute in the United States, our foreign consuls may call in assessors to act in certain criminal cases. (2) One who assesses, as taxes. The term is used in this sense both in Great Britain and the United States. His duties are mainly to adjudge the value of real and personal property and compute the taxes thereon.

ASSETEAGUE (ăs'sę-tēg') **ISLAND,** a small island off the coast of Virginia in Northampton County. Upon it is a lighthouse 150 feet in height.

ASSETS, in law, strictly the property of a debtor in the hands of his representative sufficient for the satisfaction of his creditors or legatees. Thus the property of a bankrupt is termed his assets and is the fund out of which his liabilties must be paid. All property of the debtor is assets, and it is not necessary that it should have been reduced into possession by him.

ASSIENTO, asyān'tō (Spanish, *asiento,* seat, contract, treaty), a term especially applied to an agreement between the Spanish government and a foreign nation to import negro slaves from Africa into the Spanish colonies in America, for a limited time, on payment of certain duties. The English were the sole possessors of this assiento till 1701. In 1713 the celebrated assiento treaty with Britain for 30 years was concluded at Utrecht. By this contract the English, among other privileges, obtained the right of sending a *permission* or *assiento ship,* so called, of 500 tons every year, with all sorts of merchandise, to the Spanish colonies. By the treaty of Madrid, 5 Oct. 1750, the contract was annulled.

ASSIER, äs'yä, **Adolphe d',** French philologist: b. Labastide de Séron 1828. He spent much of his life traveling, on which his earlier writings are based, but his later books are on the science of philology. He is the author of 'Le Brésil contemporain, races, mœurs, institutions, paysages' (1867); 'Souvenirs des Pyrénées' (3d ed., 1885); 'Essai de grammaire générale, d'aprés la comparaison des principales langues indo-européennes' (1857); 'Histoire naturelle du langage; Physiologie du langage phonétique' (1868); 'Le langage graphique' (1868).

ASSIGNATION. See ASSIGNMENT.

ASSIGNATS, ą-sę-nyą, or ăs-ĭg-năts, a term applied to the paper money issued during the French Revolution. The French National Assembly after appropriating to national purposes the land belonging to the Church instead of selling it at a time when its value was greatly depreciated, because of the unsettled state of affairs, issued bonds on the security of it, which were called assignats, as representing land *assigned* to the holder. This paper currency consisted chiefly of notes for 100 francs each, though many of them were for lower sums. The first issue in 1790 amounted to 400,000,000 francs. The government was relieved by this plan, for the time being the assignats saved the Revolution. This arrangement for relieving the necessities of the government seemed so easy that recourse was repeatedly had to it, as the property of wealthy emigrés, until the amount arose to the vast sum of 46,000,000,000 francs, besides many forged notes. The consequence was that the value of assignats sank to almost nothing. In March 1796, a louis d'or (24 francs) bought 7,200 francs in assignats. They were withdrawn from the currency after this, and redeemed at a thirtieth of their nominal value, by "territorial mandates," a new kind of paper currency, which empowered the holder at once to take possession of public lands at the estimated value, while assignats could only be offered at a sale. These territorial mandates afterward became almost worthless and were returned to the government in payment of taxes or of land. Early in 1797 the system came suddenly to an end.

ASSIGNMENT, a term denoting a transfer by deed of any property, or right, title or interest in property, real or personal. Assignments are usually given for leases, mortgages, and funded property. In the United States, assignment is of broader signification and applies also to the transfer of real property by certain conveyance. In general, every right of property, real or personal, and every demand connected with a right of property, real or personal; and all choses in action, as bonds, notes, judgments, mortgages, debts, contracts, agreements, relating both to real and personal property, are assignable, and the assignment thereof will pass to the assignee a right of action in the name of such assignee against all parties liable to an action. It is now most frequently used to describe the transfer of non-negotiable choses in action; and is more particularly applied to a written transfer, as distinguished from a transfer by mere delivery. Assignment carries with it all collateral securities held by the assignor for the collection of a debt or the fulfilment of a contract, and is subject to all the equities and charges which attached in the hands of the assignor. A personal trust, as the right of a master in his indentured apprentice, or the duties of a testamentary guardian, or the office of executor, trustee, etc., is not assignable. The validity of an assignment must be determined by the law of the State in which it was made, provided the thing assigned is subject of municipal or State law; but copyrights, patents, and government claims are governed by acts of Congress. In general, assignments should be recorded in the office prescribed by law, or are void as against those claiming under subsequent assignments. In a few States, filing or recording is necessary to the assignment of certain classes of choses in action, such as future earnings. In many States statutes give preference to laborers for their claims to payment of debts due them for labor furnished, and it has been generally held that these rights to priority of payment, so given or recognized, pass to the assignees of the laborer. In order to be entitled to preference, the assignee's claim must be for money advanced to the laborers themselves as distinguished from a mere advance to the employer with which to pay the laborers.

See BANKRUPTCY LAWS; BILL OF SALE; CONTRACTS.

ASSIMILATION, a term denoting the transformation of foods into living substance. The animal body is constantly changing. New compounds are being made from others; old products are cast off. There is a constant interchange of materials, some building up, others breaking down. The chief factors in the assimilative process are the foods and the oxygen in the air. Another sense of the word implies the act of making similar; also to acquire, as "assimilation of knowledge." For a discussion of the former, see DIGESTION; NUTRITION; for the latter see RESPIRATION. See also METABOLISM.

ASSIMILATION, in geology, that process by which fragments of the wall rock of an intrusive mass are broken away and melted so that they finally become a part of the molten intrusive itself.

ASSING, ä'sing, **Ludmilla,** German writer, niece of Varnhagen von Ense, who adopted her: b. Hamburg, 22 Feb. 1827; d. 25 March 1880. On the death of her mother, Rosa Maria Assing, who was a poet of some note, she was adopted by and went to live with her uncle, who gave her an excellent education. Through him she became intimately acquainted with Alexander von Humboldt. Her first notable work was a biography of the Countess Elise Ahlefeldt (Berlin 1857). On the death of her uncle she published a correspondence that had been carried on between him and von Humboldt, under the title 'Briefe Alexander von Humboldt an Varnhagen von Ense' (Leipzig 1860), which was followed by her uncle's memoirs and diary (14 vols. 1861–71). Certain references to political matters in the latter aroused the wrath of the government, with the result that she was tried and sentenced to eight months' imprisonment. In the meantime, however, she had fled to Florence, where she immediately published further instalments of the diary, whereupon she was again tried and sentenced to two years' imprisonment. In 1866, however, a general amnesty enabled her to return to Germany. Among her other works are 'Piero Cironi, ein Beitrag zur Geschichte der Revolution in Italien' (Leipzig 1867); 'Fürst Hermann Pückler-Muskau' (Hamburg 1868).

ASSINI, ăs-sē'nę, small seaport in the French Sudan, about 120 miles west of Cape Coast Castle. It taps much of the trade in that section of the Ivory Coast. Considerable coffee is being grown in the region about, but hardwood timber is the chief export. The population, mostly native, is about 3,000.

ASSINIBOIA, ăs-sĭn'ĭ-boi'ą, formerly a district in northwestern Canada, west of Manitoba, having the district of Saskatchewan on the north and Alberta on the west. On 1 Sept. 1905 Assiniboia was united with the province of Saskatchewan and the eastern portion of Athabasca to form the new province of Saskatchewan (q.v.).

ASSINIBOIN, ăs-sin'ĭ-boin, signifying stone boilers, a name applied by the Algonquian Indians to a Siouan tribe which formerly inhabited the territory between the Missouri and the Saskatchewan and who did their cooking by dropping heated stones in water. They are distantly related to the Dakotas, with whom they are able to make themselves understood in conversation. The few survivors now live on reservations in Montana and on the other side of the Canadian border, altogether numbering about 2,000. Consult Lowie, R. H., 'The Assiniboine' (in 'Anthropological Papers,' American Museum of Natural History, Vol. IV, 1910).

ASSINIBOINE, a river of Canada, which flows through Manitoba and joins the Red River at Winnipeg, about 40 miles above the entrance of the latter into Lake Winnipeg. It has a somewhat circuitous course of about 500 miles and steamers ply on it for over 300 miles.

ASSISI, ąs-sē'sē, Italy, a hill town in the province of Umbria, 20 miles from Spoleto. It is the see of a bishop and is famous as the birthplace of Saint Francis, founder of the Franciscan Order, and of Saint Clara, foundress of a religious community for women. The splendid church built over the chapel where Saint Francis received his first impulse to devotion is one of the finest remains of the architecture of the Middle Ages. Pop. (1911) 18,587. Consult "Assisi" in 'Mediæval Towns Series' (1901).

ASSISTANCE, Writ of, legal term, applied to an order issued by a court of equity to a sheriff or any other officer of similar authority authorizing him to enforce a decree for the possession of land. The English term is "writ of possession." In colonial days the term was also applied to orders issued to customs and revenue officers, authorizing them to seize goods on which duty had not been paid. Consult Quincy's 'Reports, Superior Court of Judicature, Province of Massachusetts Bay, 1761–72, with an Appendix upon Writs of Assistance' (Boston 1865).

ASSIUT, Egypt, the capital of the province of the same name, and the largest and best built town in the Nile Valley south of Cairo, from which it is distant 248 miles by rail. There are several bazaars, baths and handsome mosques. It is famous for its red and black pottery and for ornamental wood and ivory work, which find a ready market all over Egypt. It is one of the chief centres of the Copts. Here also is the northern terminus of the caravan route across the desert to Darfur. There are many archæological remains in the neighborhood. Pop. 42,000.

ASSIZE' OF ARMS. A law enacted in the reign of Henry II which enjoined every able-bodied man in the realm to maintain arms, suitable to his rank and condition of life, at his own expense. Of this law our militia is the modern offspring.

ASSIZE OF CLARENDON, regulations established by Henry II of England in 1166. They provided for juries, one in each county, each jury composed of 12 men from each hundred freeholders and four from each village. The function of this body was to present before the justices all who were charged with murder or robbery, or of harboring such criminals. Certain sections also provided for the prosecution of heretics. Consult Adams and Stephens, 'Select Documents of English Constitutional History' (New York 1901).

ASSIZE OF JERUSALEM, a code of laws in force in the Christian kingdom of Jerusalem and Cyprus. It consisted of two parts, the assize of the high court with jurisdiction over the nobles, and the assize of the court of burgesses, or code of the common people. It was supposed for some time that the laws were framed by Godfrey de Bouillon; but this is now known to be incorrect. The assize of the high court was first framed as a code about 1255, the assize of the court of burgesses, in the latter part of the 12th century, but the exact date is uncertain.

ASSIZES, an English legal term signifying the sessions of the courts held at intervals in every county by the judges. The whole country is divided into circuits, and three times in the year two judges, who are members of the highest courts in England, hold assizes in all the counties of their respective circuit. In London and Middlesex, instead of circuits, what are known as courts of *nisi prius* are held. At the assizes all the justices of the peace of the county are bound to attend, or else are liable to a fine; and also all the persons who have been summoned as grand jurymen or petit jurymen by the sheriff. At these assizes the judges sit under five separate commissions, some of which relate to civil and some to criminal causes or business. In this manner, and by these means, the jails are in general cleared, and offenders tried and convicted or acquitted at least every half year. In America there are no courts or sessions of courts technically called assizes. The judges, however, perform the same duties in the counties, within their respective circuits and jurisdictions, as the English judges, and generally in the same manner, that is to say, according to the course of the common law. Since 1808 there have been assize courts in the judicial system in France. With the English institutions, however, they have scarcely anything in common but the name. In the law of Scotland assize is the technical term applied in cases tried in the court of justiciary to the jury of 15 sworn men, selected by ballot from a greater number not exceeding 45.

ASSMANNSHAUSEN, Prussia, a village in the province of Wiesbaden, on the Rhine, on the railroad from Frankfort-on-the-Main to Niederlahnstein. It is celebrated for producing the best red wine in the Rhine provinces. It has several baths and a warm spring, which have made of it a popular health resort. Pop. about 1,000.

ASSOCIATED PRESS, a co-operative organization formed to gather news for the daily papers. Even before the Civil War the New York newspapers realized that each was paying large sums of money for news that was accessible to all. Accordingly provision was made for a joint agency which acted as a sort of clearing house through which each paper gave to all other papers (members of the agency) any news that it might receive. This formed the nucleus for the later organization known as the New York Associated Press. In 1865 the western papers incorporated their agency known as the Western Associated Press; and there were several minor associations which formed a general alliance centred in the New York association. In 1892 a general association in the nature of a stock corporation was formed, and its stockholders, being newspaper proprietors, were not allowed to hold more than eight shares of stock apiece, though, being a mutual organization in operation, it was not necessary that proprietors be stockholders in order to become members of the association or to secure its news service. In 1900 the association was changed from a stock corporation into a mutual association for such newspaper proprietors as were entitled to receive press reports. This was done 22 May 1900, when the present association was organized under New York laws. Proprietors of papers or executive officers of corporations owning papers entitled to reports constitute the membership, though only as representing their papers. The income of the association is derived from members (of which there are about 860) by weekly assessment prorated according to the cost and value of the service. The association has its own system of leased wires for its more important service (about 22,000 miles of day wires and 28,000 miles of night wires), stretching across the continent from Saint John, N. B., to Seattle, Wash., and San Diego, Cal., and from Duluth, Minn., to New Orleans, La., Galveston, Tex., and Mexico City. The number of words received and transmitted daily at each of the more important offices is 50,000, equivalent to about 35 columns of the average newspaper. See PRESS ASSOCIATIONS.

ASSOCIATION AREAS. In the brain of many lower animals as well as in that of man there are definite areas associated with other areas by sets of fibres, known as association fibres. These different areas act together in performing many of the complicated acts of human life. Thus, the general sensory area in the brain, that feels the skin sensations and determines their character, is in close association with the motor area determining the movements of the body in correspondence with the knowledge given by the sensory areas. Under the heading APHASIA several of these association areas are discussed. The studies of psychology and of mental diseases are largely concerned with the relations and connections of the association areas in the brain.

ASSOCIATION FIBRES, a term applied to those fibres that connect different parts of the brain, particularly those that unite different areas in the same hemisphere, distinguishing them from the commissural fibres that connect areas in different hemispheres, or projection fibres that bind the cerebrum with the lower cerebellar or spinal systems. These association fibres form late in childhood and on their development depends much of the increased intellectual growth of the individual.

ASSOCIATIONS OF CATHOLIC COLLEGES OF THE UNITED STATES, an organization founded in Chicago in 1899 under the guidance of Rt. Rev. Mgr. Thomas Conety, rector of the Catholic University. Its purpose is to study the questions connected with college education, to enlarge the development of college work and to advance the unification of system of Catholic education. Representatives from 53 colleges joined in the first organization of the Association, which now includes about 90 colleges, conducted chiefly by religious teaching orders of men. The studies

range from classical to commercial subjects. No uniformity of entrance requirements exist.

ASSOCIATION OF IDEAS, a phrase current in philosophy and psychology since the days of John Locke. The term «association» has had, in this connection, many different meanings. In popular psychology, it indicates the way the mind passes from idea to idea; or the way one idea suggests or «reproduces» another. Thus, in passing from the thought of gold to the recollection of a recent visit to a mining camp and then to the plot of a novel laid in a mountainous region, one may be said to «associate» the story with the idea of the mining camp, and this, in turn, with the idea of gold (see MEMORY). It is but a step from this popular conception of association — association as «reproduction» — to the notion that association is an explanation of reproduction. Association then becomes (to change the figure) not the actual passage from idea to idea, but the intangible bond which holds ideas together and which enables one idea (that is, the «gold» idea) to drag after it another (the «camp» idea). This second interpretation of the term is in disrepute among psychologists because no evidence of such a bond as the interpretation implies is to be found in consciousness. It may be urged, however, that even if association in this causal sense be undiscoverable by introspection it may, nevertheless, be regarded as a general principle of mental activity; — as the means by which the mind creates knowledge. When, however, association is thus interpreted to mean a principle underlying and conditioning the process of knowing it passes from psychology to epistemology (see PSYCHOLOGY). The doctrine of Associationism, which is connected with the names of David Hume, James Mill, Alexander Bain and other «associationists,» rests upon this epistemological meaning of the term.

Returning to the psychological use of the word «association,» we may note that the popular conception stands in need of modification and precision. (1) To say that mind «associates» idea with idea implies that ideas are by nature separate and distinct and require some «gentle force» (as Hume puts it) to bring them together. This is not true. Ideas are interwoven; they are organically connected; they are not held together as in a bundle. (2) In the second place, the popular use of the term is too narrow; a chain of actions, or of emotions, or of feelings, may be associated as well as a chain of ideas. In habitual performances, for example, — such as dressing — one act calls forth the next, this in turn the next, and so on; or emotion may be linked with emotion, as anger following fear; or, finally, associations may set out from a perception, as the thought of home from the sight of a letter. (3) Again, association does not necessarily imply a sequence of associated elements. It may be simultaneous, as well as successive; for example, I see the table before me and, at the same time, I apprehend it as a hard resisting substance, or I hear the rumble of a carriage behind me and I see, in my «mind's eye,» its form and color (see PERCEPTION). (4) Finally, association in the popular sense simply states that idea follows idea; it tells us nothing of the nature of the associated consciousness; of how, that is, an association differs from a perception. Now association, in its strict technical sense, means the associated elements of consciousness; to illustrate, it means the mass of constantly shifting processes which make up mind while one is thinking gold — mining-camp — novel. Just as there exist typical groups of mental processes which underlie the perception of a landscape, a swinging pendulum or a musical composition, there exist other typical groups — such as those already mentioned — which are known as associations.

Psychological work upon association has been directed, for the most part, upon the conditions under which associative groups arise. These conditions have, since the days of Aristotle, been set down under the heading of «principles» or «laws» of association. Thus *a* is said to call up or reproduce *b* when *a* and *b* have, at some previous time, stood together in consciousness (law of contiguity), or when *a* has been the cause of *b* (law of causality), or when *a* resembles *b* (law of similarity), etc. At the present time, these «laws» of association are usually reduced to two; the law of contiguity and the law of similarity. But even these are by no means final or adequate statements of the conditions under which associations arise; for — to point to only two or three of their imperfections — «similarity» is an extremely ambiguous term; it may mean simple likeness, or partial identity, or likeness of relationship; and «contiguity» is indefinite — it does not determine how near processes must lie in consciousness in order for one to reproduce the other. Moreover, it should be said that there are thousands of contiguity and similarity connections that are never realized in association; this follows from the fact that almost everything is, to some extent, similar to everything else, and that the elementary processes of mind have appeared «contiguously» in almost every conceivable form of combination. Both terms are, then, too broad to have much significance. If we set them down as «laws,» we have still to determine under what particular conditions a given association is formed. Many of these particular and more important conditions have been determined; they include recency, frequency, vividness (the more recently or frequently or vividly a process or group of processes has stood in consciousness the greater the liability of its appearing in an associative connection), the general interests of the individual mind (for example, botanical ideas crop up in the botanist's mind, geological ideas in the mind of the geologist) the presence or absence of inhibitory associations (if *a* has already stood associated with *b* and *c*, its chances for associating with *d* will be lessened), mood (unpleasant subjects crowd into mind when one is depressed), etc. The actual liability of a given association being formed is thus seen to rest upon a great number of possible conditions. So far as there is any truth in a general all-inclusive «law» of association it is best expressed as a law of neutral habit. This law is formulated by W. James as follows: «When two elementary brain-processes have been active together or in immediate succession, one of them, on reoccurring, tends to propagate its excitement into the other.» The relation of this law to the law of contiguity is obvious.

Consult Claparède, 'L'association des idées' (Paris 1903); Bain, A., 'Mental and Moral

Science' (London 1884); Stout, 'A Manual of Psychology' (London 1899); Jung, 'Lectures and Addresses at the Twentieth Anniversary of Clark University' (Worcester 1910); James, 'Principles of Psychology' (New York 1890, ch. xiv); Titchener, 'Experimental Psychology' (pt. II, 402 1901); Kuelpe, 'Outlines of Psychology' (trans. 1895, 177ff); Calkins, 'Introduction to Psychology' (1901, 157ff).

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ASSOLLANT, ą's'sō'län', **Alfred,** a French novelist and political writer: b. Aubusson, 20 March 1827; d. Paris, March 1880. Having traveled extensively over the United States, he published, on his return, 'Scenes from Life in the United States' (1858), a series of tales which attracted a good deal of attention. Among his numerous novels are 'Two Friends in 1792' (1859), a story of the Reign of Terror; 'Brancas' (1859), a picture of the corruption under Louis Philippe; 'Gabrielle de Chênevert' (1865), portraying the provincial nobility before the Revolution; 'Pendragon' (1881); and 'Plantagenet' (1885).

ASSOMMOIR, L', lą'sō'mwär', a novel by Emile Zola, entitled 'Gervaise' in the English translation, published in 1877. It forms one of the series dealing with the fortunes of the Rougon-Macquart family, and is a series of repulsive pictures unrelieved by one gleam of a nobler humanity, but only «realistic» as scraps; the life as a possible whole is as purely imaginative as if it were lovely instead of loathsome.

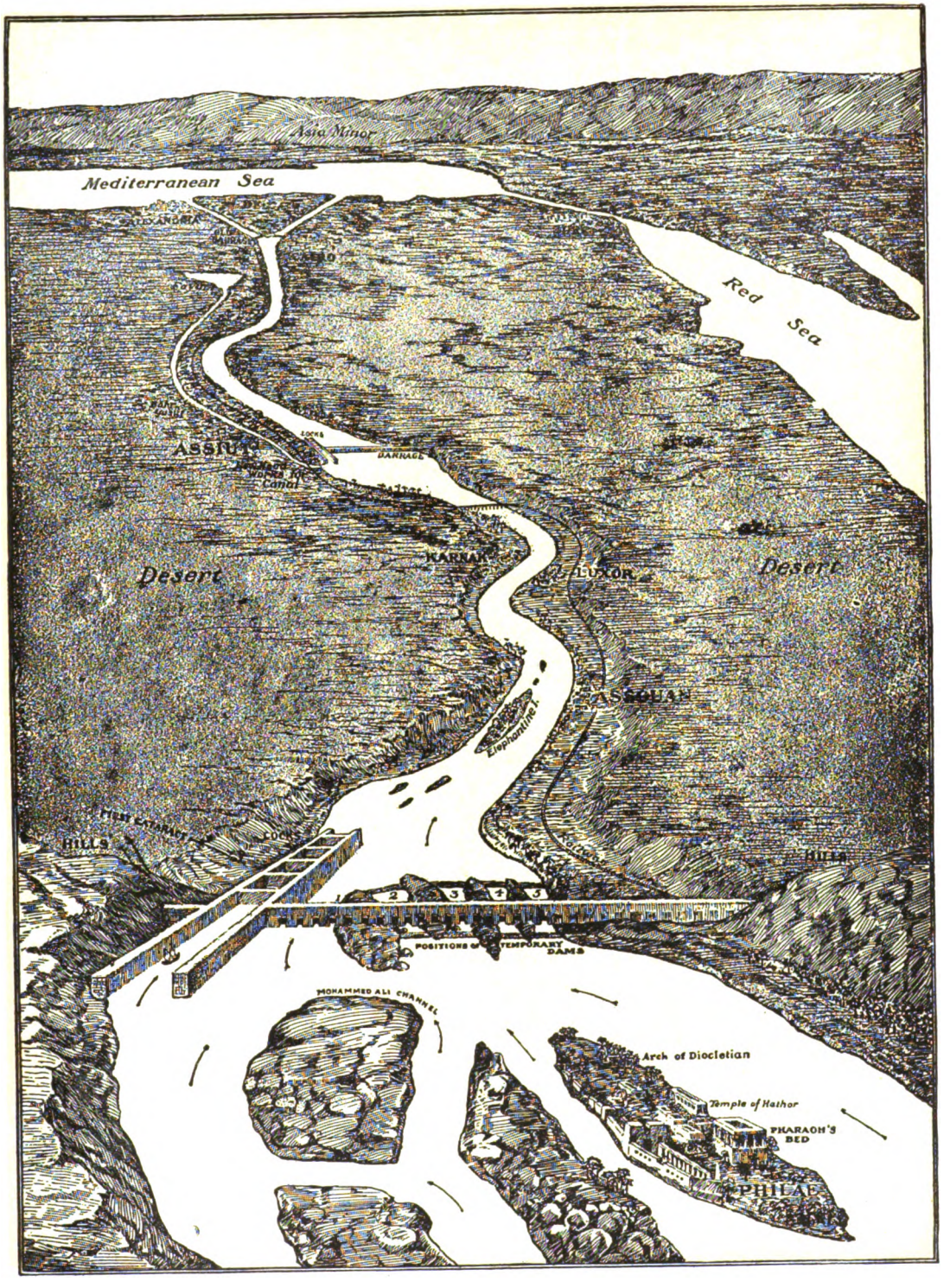
ASSONANCE, in poetry, a term used when the lines end with the same vowel-sound, but make no proper rhyme. Such verses having what we should consider false rhymes are regularly employed in Spanish poetry; as in *ligera, cubierta, tierra, mesa.*

ASSOS, ăs'ŏs, an ancient Hellenic port on the Gulf of Edremid, from whose still imposing remains the successful excavations, in 1881–83, of the American Institute of Archæology have brought to light the agora, with senate house and colonnade, a bath, theatre, gymnasium, statues of heroes, and seven Christian churches.

ASSOUAN, ą-swän', or **ASSUAN,** also called Aswan (Arabic *al suaan,* «the opening,» that is, of the Nile; the ancient Syene, whence the red granite of the vicinity — from whose famous quarries were cut under the earliest dynasties so many of the huge obelisks and colossal statues that adorned the temples and palaces of Egypt — is called syenite), capital of the province of the same name, the southernmost city of Egypt proper, near Nubia, on the right or eastern bank of the Nile, and beside the first or lowest cataract, 590 miles by rail south of Cairo. Near it are the islands of Philæ and Elephantine, the ruined monuments of the former of which are of such fascination to tourists; on the left bank are many rock tombs of the ancient dynasties. Up to the crushing of the Mahdist rebellion Assouan was an important garrison town and the central depot for the Sudan caravan trade. This, as well as its military importance, has since declined but the opening of a railway to Alexandria has increased its commercial prosperity. The chief export is senna. Assouan is also a famous health and tourist resort. Pop. (1907), including suburbs, 16,125. Of still greater importance is the new dam which has added 1,408,000 acres to the arable soil of Egypt, besides steadying the fertility of the older lands, and which is described *in extenso* below.

The monumental dam at Assouan, one of the greatest achievements of the kind in ancient or modern times, forms a reservoir in the Nile Valley capable of storing 2,423,000,000 cubic metres of water. It has not only produced a revolution in the primitive and laborious methods of irrigation in Egypt, but has reclaimed vast areas of land that have hitherto been accounted as arid and worthless. The old system of irrigation was little more than a high Nile flooding of different areas of land or basins surrounded by embankments. Less than a hundred years ago, the introduction of perennial irrigation was first attempted under Inchemet Ali by cutting deep canals to convey the water to the lands when the Nile was at its low summer level. When the Nile rose, these canals had to be blocked by temporary earthen dams, or the current would have wrought destruction. As a result, they silted up, and had to be cleared of many millions of tons of mud each year by enforced labor, much misery and extortion resulting therefrom. About half a century ago the first serious attempt to improve matters was made by the construction of the celebrated Barrage at the apex of the delta. This work consists, in effect, of two brick-arched viaducts crossing the Rosetta and Damietta, branches of the Nile, having together 132 arches of 16 feet 4 inches span, which were entirely closed by iron sluices during the summer months, thus heading up the water some 15 feet and throwing it at a high level into the six main irrigation canals below Cairo. In the summer months the whole flow of the Nile is arrested and thrown into the aforesaid canals. The old Barrage was constructed under great difficulties by French engineers, subject to the passing whims of their Oriental chiefs. About 15 years elapsed between the commencement of the work and the closing of all the sluices, and another 20 years before the structure was sufficiently strengthened by British engineers to fulfil the duties for which it was originally designed. Forced labor was largely employed in its construction and at one time 12,000 soldiers, 3,000 marines, 2,000 laborers and 1,000 masons were at work at the old Barrage.

In connection with the Nile reservoir subsidiary weirs were constructed below the old Barrage to reduce the stress on that structure. The system adopted was a novel one, devised by Major Brown, inspector-general of irrigation in lower Egypt. His aim was to dispense almost entirely with plant and skilled labor; and so, without attempting to dry the bed of the river, he made solid masonry blocks under water by grouting rubble dropped by natives into a movable timber caisson. Both branches of the Nile were thus dammed in three seasons at a cost, including navigation locks, of about $2,500,000. Many other subsidiary works have been and will be constructed, including regulators such as that on the Bahr Yusuf Canal. The most important of the works are the Barrage across the Nile at Assiut, about 250 miles above Cairo, which was commenced by Sir John Aird & Co. in the winter of 1898



ASSOUAN DAM

Bird's-eye View of the Structure and Surrounding Region

and completed in 1902, the Barrage at Zifta, designed and built by Sir Hanbury Brown, 1900–02; and the Barrage at Esna, designed by Sir Arthur Webb, built by M. McDonald, 1906–08. The great dam at Assouan, 590 miles above Cairo, is not a solid wall, but is pierced with sluice openings of sufficient area for the flood discharge of the river, which may amount to 15,000 tons of water per second. There are 180 such openings, the lower 140 are 23 feet high by 6½ feet wide, the upper 40 are 11 by 6½ feet; and where subject to heavy pressure when being moved they are of the well-known Stoney roller pattern. The total length of the dam is about 1¼ miles; the original height from foundation, about 130 feet; the difference of level water above and below, 65 feet; and the weight of masonry 149.5 pounds per cubic foot. The total excavation has been estimated at 824,000 cubic yards and the masonry at 704,000 cubic yards. Navigation is provided for by a "ladder" of four locks, each 260 feet long by 32 feet wide. As was the case at Assiut, the difficulties in dam construction are not in design but in the carrying out of the works. When the "rotten rock" in the bed was discovered, Sir Benjamin Baker reported to Lord Cromer frankly that he could not say what the extra cost or time involved by this and other unforeseen conditions would be, and that all that could be said was that, however bad the conditions, the job could be done. Lord Cromer replied that the dam had to be completed whatever the time and cost involved. The contract was let to Sir John Aird & Co., of London, with Messrs. Ransomes and Rapier, of London, as sub-contractors for the iron work, in February 1898. The engineer who designed it was Sir William Willcocks. Two months after signing the contract the permanent works were commenced, and before the end of the year thousands of native laborers and hundreds of Italian granite masons were hard at work. On 12 Feb. 1899, the foundation stone of the dam was laid by the Duke of Connaught. Many plans were considered by the engineers and contractors for putting in the foundations of the dam across the roaring cataract channels, and it was finally decided to form temporary rubble dams across three of the channels below the site of the great dam, so as to break the force of the torrent and get a pond of comparatively still water up stream to work in. Stones of from one ton to 12 tons in weight were tipped into the cataract, till finally a rubble mound appeared above the surface. The first channel was successfully closed on 17 May 1899, the depth being about 30 feet and the velocity of current nearly 15 miles an hour. In the case of another channel the closing had to be helped by tipping in railway cars themselves, loaded with heavy stones and bound together with wire ropes, making a mass of about 50 tons, the great mass being necessary to resist displacement by the torrent.

These rubble dams were well tested when the high Nile ran over them; and on work being resumed in November, after the fall of the river, water-tight sandbag dams, or "sudds," were made around the site of the dam foundation in the still waters above the rubble dams, and pumps were fixed to lay dry the bed of the river. This was the most exciting time in this stage of the operations, for no one could predict whether it would be possible to dry the bed, or whether the water would not pour through the fissured rock in overwhelming volume. Twenty-four 12-inch centrifugal pumps were provided to deal, if necessary, with one small channel; but happily the sandbags and gravel and sand embankments stanched the fissures in the rock and interstices between the great boulders covering the bottom of this channel, and a couple of 12-inch pumps sufficed. The masonry of the dam is of local granite, set in British Portland cement mortar. The interior is of rubble set by hand, with about 40 per cent of the bulk in cement mortar, four of sand to one of cement. All the face work is of coursed rock-faced ashlar, except the sluice linings, which are finely dressed. This was steam crane and Italian masons' work. There was a great pressure at times to get a section completed before the inevitable rise of the Nile, and as much as 3,600 tons of masonry was executed per day, chiefly at one point in the dam. A triple line of railway and numerous cars and locomotives were provided to convey the materials from quarries and stores to every part of the work. The maximum number of men employed was 11,000, of whom 1,000 were European masons and other skilled men. Mr. Wilfred Stokes, chief engineer and managing director of Messrs. Ransomes and Rapier, was responsible for the detailed designing and manufacture of the sluices and lock gates; 140 of the sluices are 23 feet high by 6 feet 6 inches wide, and 40 of them half that height; 130 of the sluices are on the "Stoney" principle with rollers, and the remainder move on sliding surfaces. The larger of the Stoney sluices weigh 14 tons, and are capable of being moved by hand under a head of water producing a pressure, after the heightening of the dam, of 325 tons against the gate. There are five lock gates, 32 feet wide and varying in height up to 62 feet. They are of an entirely different type from ordinary folding lock gates, being hung from the top on rollers and moving like a sliding coach-house door. This arrangement was adopted for safety, as over 1,000,000,000 tons of water are stored up above the lock gates, and each of the two upper gates is made strong enough to hold up the water, assuming that the four other gates were destroyed. After the heightening of the dam a fifth lock and gate were added. When the river is rising the sluices are open and the red water passes freely through, without depositing the fertilizing silt. After the flood when the water has become clear and the discharge of the Nile has fallen to about 2,000 tons per second, the gates without rollers are closed, and then some of those with rollers; so that between December and March the reservoir is gradually filled. The reopening of the sluices takes place between May and July, according to the state of the Nile and the requirements of the crops. On 10 Dec. 1902 the dam was formally declared complete, the total cost having been about $11,900,000. In 1907–12, in accordance with a plan prepared by Sir Benjamin Baker, it was raised about 16½ feet and its thickness increased about an equal amount. The capacity

of the original dam was thus increased from about 1,000,000,000 cubic metres to 2,423,000,000 cubic metres, its depth from about 65 feet to 88 feet, and the extent of river affected from 140 miles to 185 miles. The total cost of raising the dam was about $7,500,000. It has been estimated that each milliard of cubic metres of water suffices for the irrigation of 225,000 acres of summer crop and has a value to the treasury of about $2,500,000 per year. In 1905–06 a talus was constructed down stream at a cost of $1,413,500. Since the raising of the dam the Island of Philæ is flooded between December and May, when the reservoir is full, and is only entirely above water between August and December. Elaborate operations have taken place to preserve the ruins as far as possible from the injury which is bound to ensue from their annual submergence. It is impossible to estimate the far-reaching beneficial influence these irrigation works will bestow upon Egypt; but the reclamation of so many thousands of acres of desert for agricultural development cannot fail to improve the agricultural possibilities of the land and assist Egypt to regain the prosperity it enjoyed in the era of the Pharaohs, with a greater cultivable area than it had even then. See IRRIGATION; NILE. Consult Willcocks, 'The Nile Reservoir Dam at Assuan' (London 1903); Willcocks and Craig, 'Egyptian Irrigation' (London 1913) and Fowler, 'Heightening of the Assuan Dam' (in *Engineering News*, 30 Sept. 1909).

ASSUMPSIT, *in law,* an action to recover a compensation in damages for non-performance of a simple contract; that is, a promise, whether verbal or written, not contained in a deed under seal. The word *assumpsit* (Latin) means, he has undertaken, and was taken as the name of this action from its occurrence in declarations, that is, formal statements of the plaintiff's cause of action, when these were in Latin. Assumpsits were of two kinds, *express* and *implied;* the former being where the contracts were actually made in word or writing; the latter being such as the law implies from the justice of the case; as, for instance, if one is employed to perform service or labor, the obvious justice of paying him a reasonable sum therefor when completed raises an implication, in law, of a promise to make such payment.

ASSUMPTION, a church festival celebrating the translation into heaven of the Virgin Mary, kept on 15 August. The legend first appeared in the 3d or 4th century, and the festival was instituted some three centuries later. The story has been made the subject of a number of paintings by the most celebrated artists in history. The following are the best known: (1) Titian: in the Accademia in Venice; represents the Virgin being carried on bright clouds to heaven, surrounded by rejoicing angels, while the apostles look up from earth in amazement; (2) Titian: another painting in the Cathedral of Verona; (3) Correggio: frescoes in the cupola of the cathedral in Parma, Italy; (4) Rubens: painting in the cathedral at Antwerp, Belgium; representing the Virgin being carried to heaven, surrounded by angels, while several apostles and women are gathered at the empty tomb below; (5) Perugino: in the Accademia, in Florence; showing, in addition to the Virgin, four saints in the foreground; the representation of the Virgin is considered one of Perugino's most beautiful figures; (6) Guido Reni: a large canvas in Bridgewater House, in London; (7) Gaudenzio Ferrari: fresco in the Church of San Cristoforo, in Vercelli, Italy; showing figures of the Father, the Virgin, the angels and the apostles; (8) Murillo: painting in the Hermitage Museum, Petrograd; representing the Virgin floating.

ASSUMPTION, city in Paraguay. See ASUNCION.

ASSUR, ăs'-soor, chief god of the ancient Assyrians, who first created himself and then created all things. (See ASSYRIA). Also the name of the first capital of ancient Assyria, built on the western bank of the Tigris, 37 miles below its juncture with the upper Zab and near the modern Kalat Sherkat. It is referred to in the Bible (Gen. ii, 14). In 1903 extensive excavation was begun by the Deutsche Orient-Gesellschaft which has continued up to the present. Whole buildings, streets and quays along the ancient bed of the river have been laid bare and many objects of artistic and historical interest have been found. The city was destroyed in 606 B.C. by the Medes. Consult 'Mitteilungen der deutschen Orient-Gesellschaft' (1903–14), Andræ, 'Die Festungswerke von Assur' (1913).

ASSURANCE. See INSURANCE.

ASSURANCE, Sisters of the, a teaching Order of Sisters in the Catholic Church, founded by Monsignor Affre in Paris in 1839.

ASSURBANIPAL, ăs'soor-bā'nę-päl'. See ASSYRIA; NINEVEH; SARDANAPALUS.

ASSUS. See ASSOS.

ASSYNT, ăs'ĭnt, a wild and rugged district of Scotland. There are inexhaustible quarries of marble, both white and variegated. Fresh-water lakes are numerous; the largest, Loch Assynt, is about seven miles in length and one mile in breadth.

ASSYRIA (the *Asshur* of the Hebrews, *Athurâ* of the ancient Persians), the ancient name of a portion of Mesopotamia, lying mainly between the Euphrates and the Tigris, the seat of the earliest recorded monarchy. In the earliest times it was probably limited to the low-lying tract between the Jebel Makloub and the little Zab (Zab-Asfal), on the left bank of the Tigris; but at its greatest extent Assyria must have been nearly 500 miles long, with an area of about 100,000 square miles. Toward the north Assyria bordered on the mountainous country of Armenia, which was at times under Assyrian dominion, but which at no time was considered as an actual part of the country. On the east dwelt numerous independent and warlike tribes, sheltered by the fastnesses of the Zagros Mountains. On the southeast Susiana or Elam was the frontier state east of the Tigris, while Babylonia occupied the same position between the rivers. Southwest of Assyria lay Arabia, and higher up Syria and the land of the Hittites. The chief cities of Assyria in the days of its greatest prosperity were Nineveh, whose site is marked by the mounds opposite Mosul (Nebi Yunus and Kuyunjik), Calah (or Kalakh, the modern Nimrud), Assur (or Al Asur, Kalât Sherkat), Sargina (Khorsa-

bad), Arbela (Arbil), etc. The surface of the country within its widest limits was of a diversified character. On the north and east the lofty mountain-ranges of Armenia and Kurdistan are succeeded by low ranges of arid limestone hills, occasionally enclosing fertile plains and valleys. Immediately south of this is a well-watered, productive and undulating belt of country, into which run limestone rocks of a golden color and wooded with dwarf-oak. This sinks suddenly down upon the great Mesopotamian plain (the modern El Jezireh), about 250 miles in length, interrupted only by a single limestone range branching off from the Zagros Mountains across the plain. The numerous remains of ancient habitations show how thickly this vast flat must have once been peopled; now, for the most part, it is a mere wilderness.

History.— Scripture tells us that the early inhabitants of Assyria went from Babylon, and the traditions of later times, as well as inscriptions on the disinterred Assyrian monuments, and the character of those remains go to show that the power and civilization of Babylon were earlier than those of Assyria. In Genesis x, 11 it is mentioned that Nineveh was founded by Assur, but for long the country was subject to governors appointed by the kings of Babylon. We learn from monumental inscriptions that about 1820 B.C., when Assur was the capital of the country, Shamshi-Adad III founded temples there to Assur, the great national deity, and to Anu and Adad, besides a temple to the goddess of Nineveh in the city of that name. The Assyrian rulers gradually began to treat with their southern neighbors on equal terms, the boundaries of the two countries were for a time clearly marked out, and intermarriages among the reigning families occasionally took place. About the latter end of the 14th century Shalmaneser I acquired the whole of Naharina (the country round the sources of the Euphrates and Tigris) by conquest, and planted Assyrian colonies there; he also founded the city of Calah or Kalakh and restored the great temple at Nineveh. About 1300 B.C. he was succeeded by his son Tukulti-Ninib I, who conquered the whole of the valley of the Euphrates and built or restored the palace at the city of Assur. The five following reigns were occupied with wars, more or less successful, with the Babylonians. About the year 1107 B.C. Tiglathpileser I, one of the most eminent of the sovereigns of the first Assyrian monarchy, ascended the throne, beginning his reign by the conquest of the Syrians and Hittites in the west. He then carried his arms far and wide, subjugating the Moschians, Commagenians, Urumanians and other tribes in the north; on the south he shattered the Babylonian power and took their capital. But this empire, acquired and ruled by the energy and genius of one man, began to fall to pieces at his death. The period of decline lasted over 200 years, during which time little is known of Assyrian history. Under Assurnasirpal, who reigned from 884 to 858 B.C., Assyria once more advanced to the position of the leading power in the world. The extent of his kingdom was greater than that of Tiglathpileser, and the magnificent palaces, temples and other buildings erected during his reign, with their elaborate sculptures and paintings, proved that wealth, art and luxury must have reached a high stage of development. When he ascended the throne Nineveh was the capital of the kingdom, but he restored and beautified Calah, which had suffered during the troubled and declining years of the country, made it his favorite residence, and raised it to the dignity of the chief city of the state. Among the first acts of his reign was the suppression of a revolt by the Assyrian colonists of Naharina (883). This was followed by the victorious campaigns in Zamua on the eastern frontier (882–881), against several rebellious provinces in the northwest (880), and against the Shukhi or Shuhites, who then occupied a tract of country between Babylon and Assyria (879). In another expedition he crossed the Euphrates and advanced to the Mediterranean, near the mouth of the Orontes. In 858 Assurnasirpal was succeeded by his son Shalmaneser III, whose career of conquest was equally successful. The closing years of his reign were troubled by the rebellion of his eldest son, Assur-danin-apli, who had gained over to his side the cities of Nineveh, Assur, Arbela and other important towns. After much fighting the rebellion was put down by Shalmaneser's second son Shamshi-Adad V. who succeeded to the throne in 823. The old dynasty came to an end in the person of Assur-nirari V, who was driven from the throne by a usurper, Tiglathpileser, in 745, after a struggle of some years. (See ASSYRIOLOGY). Tiglathpileser IV was driven from his throne by another claimant named Shalmaneser V. (727). (See ASSYRIOLOGY). His successor was Sargon II (722–705). (See ASSYRIOLOGY). The attitude of Babylonia now began to look extremely dangerous. Merodachbaladan, a Chaldæan leader, taking advantage of the troubles which closed the reign of Tiglathpileser, had possessed himself of Babylonia and held it for 12 years, strengthening himself by alliances with Egypt and the various rulers of Palestine. In 710 Merodach-baladan was driven out of Babylonia; in a single campaign the allies were crushed, Judah was overrun, and Ashdod leveled to the ground. Sargon spent the latter years of his reign in internal reforms, and in founding or beautifying several cities of his kingdom. A new city, called Dur-Sargina, was founded to the north-northeast of Nineveh, now Khorsabad, the library of Calah was restored and enlarged, and special attention was devoted to law reform. In the midst of these labors Sargon was murdered, and was succeeded by Sennacherib, one of his younger sons, in 705.

No sooner was Sennacherib seated on the throne than he was compelled to take up arms against Merodach-baladan, who had again obtained possession of Babylon. In 701 fresh outbreaks in Syria led him in that direction. He first swept down on Sidon, the King fled to Cyprus, and Sennacherib seated Tubal on his empty throne. Next he deposed Zidqa of Askelon, and advanced against Ekron and Judah. The people of Ekron had dethroned Padi, their King, and gave him into the hands of Hezekiah, King of Judah. The Egyptian and Ethiopian forces advanced to the assistance of their Judean allies, but Sennacherib totally routed the confederates at Elteku, and he rapidly overran Judah, taking 46 of its fortified cities. Hezekiah now submitted and paid the conqueror a sum of 30 talents of gold and 800 talents of

silver. Padi was given up and restored to Ekron, and Sennacherib chastised the rebels. His expedition into Syria is one of the most memorable in the history of Assyria, and is briefly recorded in 2 Kings xix. But his career of conquest was stopped by an appalling catastrophe: his army lay before Libna, when in one night "the angel of Jehovah went out and smote in the camp of the Assyrians 185,000 men" (2 Kings xix, 35). Sennacherib himself returned to Assyria, and occupied much of the last years of his reign in repressing the outbreaks of the Babylonians and Elamites, in constructing canals and aqueducts, and in entirely rebuilding Nineveh. In 681 he was murdered by his two sons, Adrammelech and Sharezer, but they soon found themselves confronted by a veteran army under Esarhaddon, their father's younger and favorite son, who defeated them in a battle at Khanigalbat, and assumed the crown (680). See ASSYRIOLOGY.

Esarhaddon ruled vigorously for 12 years (680–668). (See ASSYRIOLOGY). The King died the next year. At the climax of Assurbanipal's reign constant wars were beginning to exhaust the men and treasure of the empire; and luxury, which had flowed in suddenly like a flood, was enervating the people. The King now no longer appeared at the head of his army, but entrusted it to generals, and abandoned himself to indolence and sensuality. Assurbanipal was a zealous patron of the arts; learned men from all countries were welcomed to his court; literary works were collected from all sources; the library of Nineveh was greatly augmented; the study of the dead language of Akkad was encouraged and dictionaries and grammars were compiled. The buildings were unrivalled for magnificence, his palace glittered with gold and silver and was adorned with the rarest sculptures. Unfortunately the King's character was marked by cruelty and sensuality, and his example descended through the court to the people. He died in 626 and was succeeded by his son Assur-etil-ilâni under whom Babylon definitely threw off the Assyrian yoke. The country continued rapidly to decline, fighting hard for mere existence until, under its last king, Sin-shar-ishkun, Nineveh was captured and destroyed by the Medes in 606 B.C.

Ethnology, Language, Religion, etc.— The original inhabitants of Assyria and Babylonia are thought by some scholars to have belonged to that race variously called Turanian, Ural-Altaic, Scythian, or Tatar, and which appears at one time to have occupied the entire region from the Caucasus to the Indian Ocean, and from the Mediterranean to the delta of the Ganges. The ancient inhabitants of Babylonia, therefore, were possibly of the same stock as that from which the Finns, Turks and Magyars have descended; and their language, which has been preserved to us in inscriptions, and is known by the name of Sumerian, is allied to the Ugro-Bulgaric division of the Finnic group of languages. The Sumerian race descended from the mountainous region of Elam on the east, and the origin of Chaldæan civilization and writing was due to them. In course of time, however, a Semitic race of people spread themselves over the country and mingled with or supplanted the original inhabitants, while their language took the place of the Sumerian, the latter becoming a dead language. Belonging to the Semitic family, these later Assyrians were thus members of the same great division of the human race as the Hebrews, Syrians, Phœnicians and modern Arabians. The language differed little from the Babylonian, which was characterized by a preference for the softer sounds and a fuller use of the vowels. Both languages retained traces of the influence of the earlier Sumerian. Assyrian is closely allied to Hebrew and Phœnician; it has their peculiarities of phonology, vocabulary and grammar, and some obscure points in Hebrew etymology have been cleared up by its aid. The language changed little throughout the 1,500 years during which we can trace its career in the recently deciphered inscriptions. It continued to be written with the cuneiform character down to the 3d century B.C. Assyria could boast of but little native literature; it was a land of warriors, and the peaceful arts had their home in Babylonia. It was not until the time of Assurbanipal that any attempt was made to rival Babylon in learning. Their original works were for the first time composed, and treatises were composed even, in the dead Sumerian language. The greater part of the literature was stamped in minute characters on baked bricks, but papyrus was also used, although no books in this form have come down to us. The subjects of the Assyrian literature comprise hymns to the gods, mythological and epic poems and works on history, chronology, astrology, law, etc. (See BABYLONIAN LITERATURE). The Assyrian religion, like the language and arts, was in most essential points derived from Babylonia. There were the same gods, the same ceremonials and prayers, and even the temples had the same names. There is, however, in one point a notable difference. In addition to the worship of the Babylonian deities the Assyrians adored their national deity Assur, placing him at the head of the Pantheon. He was called king of all the chief gods, the god who created himself, it being supposed that he was self-existent and the creator of all things. After Assur come the 12 chief deities, Anu, god of heaven, ruler of angels and spirits; Bêl, the father of the gods; Ea, king of the sea; Sin, or the Moon, lord of crowns; Shamash, or the Sun, judge of heaven and earth; Ninib, god of hunting; Nergal, god of war; Nusku, bestower of sceptres; Beltis, mother of the gods; Ishtar, leader of heaven and earth, and Bêl, or Merodach, lord of Babylon. Most of those divinities had consorts, who were not, however, admitted to the first rank of the gods. Below this first rank was a number of spirits, good and evil, who presided over the minor operations of nature. There were set forms regulating the worship of all the gods and spirits, and prayers to each were inscribed on clay tablets with blanks for the names of the persons using them.

Art and Science, etc.— Although in art, as in other things, Assyria was the pupil of Babylon, there was yet a notable difference between its development in the two countries, due partly to two causes. The alabaster quarries scattered over the country supplied the Assyrians with a material inaccessible to their southern neighbors on which they could represent, far better than the Babylonians on their enameled bricks,

the scenes which interested them. Sculpture was naturally developed by the one, just as painting was by the other, and the ornamentation which could be lavished on the exterior of buildings in Assyria had to be confined to the interior in Babylonia. The Assyrian artists, faithful and indefatigable, acquired a considerable power in representing the forms of men and animals, and produced vivid and striking scenes of the chief occupations of human life. If they did not strive greatly after the ideal, and never in this direction reached a very exalted rank, yet even here their emblematic figures of the gods have a dignity and grandeur which implies the possession of some elevated feelings. But their grand merit is in the representation of the real. Their scenes of war and of the chase, and even sometimes of the more peaceful incidents of life, have a fidelity, boldness and lifelike appearance which place them high among the realistic schools. Unlike that of the Egyptians, which remained comparatively stationary from the earliest to the latest ages, the art of the Assyrians is plainly progressive, becoming gradually more natural and less uncouth, more lifelike and less stiff, more varied and less conventional. It may be said to have reached its highest stage of development in the reign of Assurbanipal when it was characterized by great chasteness and softness, delicacy and finish. The beginning of Greek art coincides with the decadence of the Assyrian, and there can be no doubt that the Hellenic artists owe much to their Assyrian predecessors. The advanced condition of the Assyrians in various other respects is sufficiently evidenced by the representations on the sculptures and by the remains discovered among their ruined buildings. We now know that they understood and applied the arch; that they constructed tunnels, aqueducts and drains; that they used the lever and the roller; that they engraved gems in a highly artistic way; that they understood the arts of inlaying, enameling and overlaying with metals; that they manufactured porcelain and transparent and colored glass, and were acquainted with the lens; that they possessed vases, jars and other dishes, bronze and ivory ornaments, bells, gold earrings and bracelets of excellent design and workmanship. Their household furniture also gives us a high idea of their skill, taste, minuteness and accuracy. The cities of Nineveh, Assur and Arbela had each its royal observatory, superintended by an astronomer-royal, who had to send in his report to the king twice a month. At an early date the stars were numbered and named; a calendar was formed, in which the year was divided into 12 months (of 30 days each) called after the zodiacal signs, but as this division was found to be inaccurate an intercalary month was added every six years. The week was divided into seven days, the seventh being a day of rest; the day was divided into 12 *casbu* of two hours each, each casbu being subdivided into 60 minutes, and these again into 60 seconds. Eclipses were recorded from a very remote epoch, and their recurrence roughly determined. The principal astronomical work, called the 'Illumination of Bêl,' was compiled for the library of Sargon of Agade; it was inscribed on 70 tablets, and went through numerous editions, one of the latest being in the British Museum. It treats, among other things, on observations of comets, the polar star, the conjunction of the sun and moon and motions of Venus and Mars. The study of mathematics was fairly advanced, and the people who were acquainted with the sundial, the clepsydra, the pulley and the lever must have had considerable knowledge of mechanics. See ASSYRIOLOGY.

Government.— Like all the ancient monarchies which attained to any considerable extent, Assyria was composed of a number of separate kingdoms. In the East conquest has very seldom led to amalgamation, and in the primitive empires there was not even any attempt at that governmental centralization which we find at a later period in the satrapal system of Persia. The Assyrian monarchs reigned over a number of petty kings, the native rulers of the several countries, over the whole extent of their dominions. These native princes were feudatories of the Great Monarch, holding their crowns from him by the double tenure of homage and tribute. This system naturally led to the frequent outbreak of troubles. See CUNEIFORM WRITING; NINEVEH; NIPPUR.

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ASSYRIOLOGY. Assyriology may be defined as that department of study and investigation which embraces within its realm the country, people, languages, literature and history of ancient Mesopotamia, Babylonia and so much of adjoining countries as shared in the life of the Semitic valley-peoples prior to 538 B.C. The term is often popularly employed to cover a study of those languages written in the cuneiform script, or their immediate antecedents, the linear and picture methods of writing, current in primæval times in this great river valley. Such a delimitation of our theme would include a study of early Babylonia, Assyria, somewhat of Elam and somewhat of later Persia, and slightly of the Greek period. Assyriology, therefore, deals with an antiquity which was centred in the great Babylonian Valley, and embodied in the cuneiform languages.

Age.— This is a comparatively new department of research. It has been built up upon the basis of the discoveries of antiquities which have been made during the last three-quarters of a century in the countries tributary to the Persian Gulf. The tentacles of this department reach out into every phase of ancient Oriental life and knowledge, and require of the modern investigator a comparatively comprehensive understanding of the complexities of that primitive life. This department includes in its sphere some of the most important of all branches of ancient lore. Among these we note especially Semitic philology, general archæology, architecture, sculpture, history, legend, so-called

science, and religion. Assyriology has already taken its place as one of the great departments of human knowledge and research. The results of its investigations must now be reckoned with in any estimate of early Semitic legends, traditions or history. Its importance to the student of the Old Testament is assuming greater proportions with each old site overturned by the spade of the excavator. The great museums of Europe and America count among their chief treasures the magnificent colossi, bas-reliefs, slabs, statues and tablets that belong to the department of Assyriology.

Names.— The oldest of the governments represented in Assyriology is that centred in the Babylonian Valley. Its earliest known mention at the beginning of the last century was that found in Genesis x, 10, where the beginning of the kingdom of Nimrod is said to have been Babel (Hebrew, בבל), probably the city of Babylon, "in the land of Shinar" (Hebrew, שנער), a name for lower Babylonia. In post-exilic times the country was designated Chaldea, or "land of the Chaldeans" (Hebrew, ארץ כשדים), Ezek. i, 3. Classical writers named this country after Babylon, that metropolitan city of their day, Babylonia, and this name has been attached to it down to the present time.

The next great country covered by Assyriology is Assyria. The Hebrews called it (Gen. x, 11) Asshur (אשור), either the name of a personage, of a city or of a country, probably the last. The translators of the Septuagint called it *ασσουρ* and *ασσυριος*, while Josephus, a couple of centuries later, refers to it as *Ασσυρία*. The Aramæans named it *Athur*, or *Athuriya*, the Persians *Arthurâ*.

Boundaries.— The territory covered by ancient Babylonia was delimited on the west by the Arabian Desert, on the south by the Persian Gulf and Arabian Desert, on the east by Elamite territory backed up by the Zagros Mountains, and on the north by the uplands of Assyria. Assyria proper, in its primitive period, was delimited on the east by the mountains of Kurdistan, on the north by those of Armenia, on the south by Babylonia, with an ever-shifting boundary line, and on the west by the western limits of the Tigris Valley and plain. In a word, Assyria was anciently seated in the upper Tigris Valley, in possession of several great city-centres.

These two important countries were thus largely guarded by nature from foes on the south and southwest, but were always open to the intrigues of invaders from the east, north or northwest. The historical records of these lands confirm this statement.

Description.— The great valley of Babylonia derives its marvelous fertility from its two notable rivers, the Tigris and Euphrates. Both have their rise in the mountains of Armenia, and both have their debouchement in the Persian Gulf. The Tigris, from its source, flows in a southeasterly and southerly direction, cutting through the uplands of Assyria, and along the eastern side of the Babylonian Valley, until, mingling with the waters of the Euphrates, it falls into the Persian Gulf. The Euphrates, from its source, flows toward the southwest and bends southward within 100 miles of the Mediterranean Sea, and thence in general toward the southeast and south until, in union with the Tigris, it pours into the same gulf. These two arterial streams are the life of this great lower valley. By irrigation they were made to fertilize all their adjacent lands, and thus placed these among the richest countries on earth. In addition to water these streams bring annually from the mountains of Armenia great quantities of alluvium and deposit it in the lower valley. Geologists estimate that the shores of the Persian Gulf have been pushed southward, by deposits of this alluvium, fully 125 miles since the earliest periods of Babylonian history. In other words, the Tigris and Euphrates rivers that now enter the Gulf as one stream forming a vast morass, formerly had separate mouths, about 125 miles north-northwest of their present outlet. If this estimate be correct, the ancient Ur of the Chaldees (modern *Mugheir*) was practically a seaport city. The Tigris, being the shorter river, has a very swift current, and is less valuable for navigation than the Euphrates. Upon this latter stream vessels of profitable draft may ride to a distance of 800 miles above its mouth. The territory of Mesopotamia proper is watered by the Balikh and Khabur, two rivers that flow southward, emptying into the Euphrates above the site of ancient Babylon. The region of Babylonia proper, though a waste to-day, shows marks of having supported a dense population in antiquity.

References to Ancient Peoples.— Present-day students and scholars inferred from frequent references in the Old Testament and in the compiled works of Berosus, Manetho, Josephus and others that this valley had been the headquarters of mighty nations. Classical writers carry echoes of an ancient glory won by great armies and powerful monarchs from the East, whose records were otherwise unknown, and whose mighty deeds seemed as unreal as fiction. The rise, conquest and reign of these giant figures aroused the enthusiasm of every student of ancient history. The far-reaching influence and power over neighboring kings of these monarchs, dimly outlined in the vague second-hand records, set scholars to work. It drove them to search far and wide for other traces of peoples who had completely perished from the face of the earth, and who had, so far as they could see, left no story of their achievements. The reports of travelers who had passed through and spent some time in those countries attracted their attention.

Ancient Remains.— The entire territory drained by the two great rivers, Tigris and Euphrates, was found to be dotted by extensive mounds, ruins of ancient walls, piles of disintegrating towers, beds of ancient irrigating canals and other marks of a once elaborate civilization. Travelers had often picked up near these mounds little bits of antiquities, bricks, tablets and cylinder seals, that carried on their surfaces many curious wedge-shaped characters, which they regarded either as writing or ornamentation. These miscellaneous curios were thought to represent the civilizations of an unknown past, of peoples who occupied this territory in the days when prosperous cities and fruitful fields filled this great valley.

Earliest Excavations.— The first persons to take an active interest in the ruins of Babylonia and Assyria were Englishmen resident as government officials in some one of the chief modern cities of that country. C. J. Rich, a resident of Bagdad (1808–21), carefully ex-

amined and described several mounds, and some inscriptions, in small works published during his residence. These attracted considerable attention. But the first systematic excavations within this valley were undertaken by P. E. Botta, French consul at the time in Mosul, a modern city of some commercial and political importance on the upper Tigris River, in 1842–45. He began work on the colossal mounds opposite Mosul, on the east bank of the Tigris River; but he had little success until he transferred his force to the mound Khorsabad, about 14 miles north-northeast of the first site. Khorsabad proved to be an immense treasure-house of antiquities. Here he uncovered the stupendous royal palace which later proved to be that of Sargon II (722–705 B.C.), with a mass of inscriptions and antiquities of various kinds. This splendid find was greeted with enthusiasm by the scholarly world, and set minds to thinking and wills to acting to uncover other antiquities representing such a marvelous past. In 1845–47, A. H. Layard, an Englishman, began to dig at Nimroud, the ancient Calah, a mound about 20 miles south of Mosul, on the east bank of the Tigris. Persevering through almost indescribable difficulties, Layard finally succeeded in bringing to light the palaces of Assurnasirpal (884–858 B.C.), Shalmaneser III (858–823 B.C.) and Esarhaddon (680–668 B.C.). In 1849–51 this same intrepid excavator burrowed into the mound Kuyunjik, one of the mounds of ancient Nineveh, and laid bare two more great palaces, that of Sennacherib (705–680 B.C.), and that of Assurbanipal (668–626 B.C.). Botta's finds, so far as transportable, were taken to Paris and deposited in the Museum of the Louvre; those of Layard to the British Museum in London, but the largest objects were again buried for their better preservation.

In this same period, Hormuzd Rassam, trained under Layard, made some valuable discoveries (1851–54) at Kuyunjik for the English; and Victor Place at Khorsabad and Fulgence Fresnel and Jules Oppert at Hillah for the French. In most of the work undertaken by the English, Henry C. Rawlinson was a close adviser and an enthusiastic promoter.

Later Excavations.— The next 20 years (1854–73) were a period of cessation of excavations of any note. An occasional traveler or explorer found a few specimens of antiquities and did a little desultory work. This 20 years, however, saw the publication of many notable works by Botta, Layard, Place, Oppert and Rawlinson on the results of the active work of excavating and of the decipherment of inscriptions previously gathered out of the mounds. The second period of excavations began in 1873, when George Smith, of the British Museum, who had found some fragments of tablets describing a deluge, was sent by the London *Daily Telegraph* to the site of ancient Nineveh to find other fragments of the same kind. Smith's phenomenal success in finding Assurbanipal's 30,000-tablet-library gave new life to archæological research, and was the immediate cause of his being sent on three expeditions, on the last of which he succumbed to a fever at Aleppo 19 Aug. 1875. Smith's genius had presented to the world such representations of the important discoveries made by himself and others that the contagion spread, and other centres of scholarship turned their eyes toward the mounds of Babylonia and Assyria. Rassam was again called into requisition, and in 1877–78 gathered rich spoils on the site of old Nineveh, at Nimrud, and at Balawat, where he found the remains of the bronze doors of Shalmaneser III (858–823 B.C.). In 1878–79 and 1880–81 he also found valuable relics on Babylonian ground.

From 1877 to the present day the French government has conducted excavations intermittently at Telloh, in lower Babylonia; for more than 23 years under the superintendence of E. de Sarzec, and since that date under Commandant G. Cros. This mound has yielded a rich store of antiquities, consisting of many thousands of tablets, of several beautiful diorite statues, of friezes, of palace plans, and of cylinders, many of which are deposited and mounted in the superb collection in the Louvre in Paris. These represent the remains of the old Sumerian civilization of the 3d and 4th millenium B.C. The accompanying illustration presents two views of a part of the mound Telloh, where such notable discoveries have been made. The same government inaugurated and carried on excavations at Susa under M. and Mme. Dieulafoy (1884–86); and latterly under M. J. de Morgan, and has thus opened up new volumes on the history of ancient Elam and its relations to adjoining countries.

A few broad-minded gentlemen, under the leadership of E. W. Clark, of Philadelphia, provided the means for the organization and prosecution of an expedition to Babylonia under the auspices of the University of Pennsylvania. This expedition was duly organized and equipped and prosecuted work under the direction of John P. Peters, during 1888–90 at the mound Niffer, about 30 miles southeast of Babylon. Since that time the same institution has carried on work intermittently on this site, under supervision of H. V. Hilprecht, and, for the most part, under the directorship of John Henry Haynes, and has brought to light thousands of inscriptions and other antiquities. These have made the University of Pennsylvania the richest Babylonian-Assyrian museum in America in antiquities of both the Sumerian and Semitic population of early Babylonia.

Beginning with the year 1897 German archæologists under the leadership of Robert Koldewey have carried on extensive excavations on the site of old Babylon and the old city of Ashur. The full results of their activity are being published in beautifully illustrated volumes and series of texts.

In 1903 the Oriental Exploration Fund of the University of Chicago was organized, and an expedition sent out under the direction of Robert Francis Harper, and under the field directorship of Edgar James Banks, to excavate on the old site Bismya, in lower Babylonia. The first season's work justified the hope that this might prove to be a fruitful mound, belonging to a high antiquity. The old city proved to be the ancient Adab, and the many antiquities uncovered, including a famous statue, now in the Imperial Ottoman Museum at Constantinople, to belong to the 3d millenium B.C.

Outside of Babylonia proper, some notable discoveries of cuneiform inscriptions have been made by explorers. A stèle of Sargon II was found in the Island of Cyprus in 1845. There were found at Tel-el-Amarna, in Egypt, in 1887, more than 300 cuneiform tablets, which proved

to be correspondence between the kings of Egypt and their Asiatic underlords and rulers in the 15th century B.C. Even Palestine has produced a couple of tablets in its excavated cities. Luschan found at Zinjirli, Asia Minor, among a host of Hittite antiquities, a statue and inscription of Esarhaddon (680–668 B.C.). And the Germans under the leadership of Hugo Winckler brought to light at Boghaz-Keui a splendid collection of cuneiform tablets, in Sumerian, Babylonian and the Hittite languages (first reported in 1906).

Decipherment of Inscriptions.— The neat little wedge-shaped characters, put together in so many combinations to form individual signs, very early attracted the genius of the linguist. As early as 1801, Grotefend, a German, discovered the significance of some of the old Persian cuneiform characters; and other scholars, following in his wake, likewise made some advance in identification of those old characters. But the long and sure step ahead was not made until Henry C. Rawlinson, the Englishman, took up the problem. As an officer in the Persian army about 1835, he had unusual facilities for examining ancient ruins in that country. He observed at Behistun, in the Zagros Mountains, a rock stretching up almost 1,700 feet above the plain, and at about 350 feet above its base a large space carefully smoothed off. Upon this space was inscribed a mass of writing, distributed in several columns of varying lengths. After years of toil at intervals, he succeeded in copying the entire set. In a study of them he found that they contained three languages. The first, the Old Persian, through his knowledge of modern Persian and other related tongues, after years of study, he was able to decipher, and sent his translation to London, where, in 1847, it was published in the *Journal of the Royal Asiatic Society*. Rawlinson's success was epochal, for it broke the seal into the hidden treasures of the cuneiform languages of Babylonia. His decipherment of one of the trilingual inscriptions opened the door into the next, the Susian or Elamite. These two being deciphered, scholars were soon able to penetrate the mysteries of the third language, the Babylonian-Assyrian.

These triumphs extended, roughly, over the years 1845–55. In 1857 the British Museum made a test of scholars' ability to decipher the Assyrian tongue. Four men, H. C. Rawlinson, Edward Hincks, Jules Oppert and H. F. Talbot, were given a fine copy of a long historical inscription of Tiglathpileser I (ca. 1107 B.C.), and were requested each to make an independent translation of the text and report on their results. At a given time these scholars reported; and to the amazement, one should say, of all concerned, their translations were in substantial agreement from first to last. This was the crowning triumph of all in the eyes of other departments of learning. It showed that the riddle had been solved, that the Babylonian Valley would henceforth speak for itself through its multitudes of ancient records.

Furthermore, this triumph of philology succeeded in placing in the galaxy of ancient nations some of the most powerful of peoples. Babylonia, Assyria and Elam henceforth became the early home of vigorous nations, well-organized governments, conquering armies and world-wide rulers. The ruin-covered wastes were suddenly transformed into fertile fields and prosperous cities, occupied by peoples whose influence touched the horizon of civilization in every direction. In short, this triumph of philology opened a door to a new world in southwestern Asia, prior to, and contemporaneous with, the times of the Hebrew kingdom.

Language.— The language in which this new-old material is preserved is the so-called Babylonian-Assyrian wedge-writing. Although the Old Persian is alphabetic, the Babylonian-Assyrian is a sign and syllable tongue. Each separate wedge ( ), or each combination of wedges ( ), constitutes a sign. This language was written by pressing the wedges with an instrument into clay or cutting them into stone or metal, for they never appear in relief. The primitive signs were probably rude pictures, which gradually grew through use into the form of curved and straight lines; these lines soon took on the artistic form of wedges. This evolution is seen in the fact that a large number of the signs possess merely an ideographic value; for example, we find a sign for the idea "land" ( ), "sun" ( ), "male" ( ), "female" ( ), "make," "fish," "king," etc. Some of these signs also possess a syllabic value, as *da, ra, la, mat, lak, rid, sun, pad,* etc. Quite a number possess several syllabic values, the context being the reader's only guide as to which should be used in any given case. The reader's troubles are still more aggravated by the fact that the same sign sometimes has both ideographic and syllabic values. In this, as in the preceding case, the reader's skill must find in the context the reason for the reading which he should adopt.

There are about 600 independent and entirely distinct signs formed by combinations of anywhere from two to 30 wedges set together at different angles, or paralleled, or inserted within other combinations. But the great difficulties arise when we find that there were almost numberless combinations of anywhere from two to six different ideographic signs to express other and often compound ideas. There are fully 20,000 such combinations known to-day to Assyriologists.

The number of inscriptions, small and large, discovered in Babylonia up to the present, is about 150,000. At Telloh, the French alone found in one library 30,000; and at Nippur the University of Pennsylvania secured 20,000, all large aids in our quest.

This Babylonian-Assyrian language is Semitic in character, though its soil is thought, by most English, German and French scholars, to be a non-Semitic tongue, the so-called Sumerian, in which most of the valuable finds made by the French at Telloh are written, and some of the inscriptions found at Nippur. The Babylonian-Assyrian tongue is a half-sister to the Hebrew of the Old Testament, and has already proved its real value in the interpretation of that book. See ASSYRIA.

The People.— The peoples best known to Assyriology are Semites. The primitive inhabitants of Babylonia, the predecessors of the Semitic population of Babylonia and Assyria, were probably a mixture of various nationalities, with the Sumerians in the lead. Whence the Sumerians or Semites came has not been positively ascertained. The Semites were in the

BLACK DIORITE STATUE OF GUDEA FROM TELLOH (*after de Sarzec*)

(About 2800 B. C.)

(Now in the Louvre, Paris)

RELIEFS ON THE BLACK OBELISK OF SHALMANESER II. (860–825 B. C.)

(Found by Layard at Nimroud, now in the British Museum)

Second tier represents Jehu, King of Israel, rendering submission to Shalmaneser II. (About 842 B. C.)

land by 4,000 B.C. Side by side they lived and amalgamated in succeeding years. These Sumerians were the predecessors and probably for a long time the contemporaries of the Semites, the one-time-supposed inventors of the ideographic cuneiform language of those countries. We know, at least, from inscriptions found at Nippur, that the Semitic language was in use in Babylonia as early as the 4th millenium B.C. The population of Babylonia and Assyria in later historic times was Semitic. Their location made them warriors, for they had to be perpetually on the defense. The Babylonians cultivated the peaceful arts and were wide awake to the best things of life in their time and day. The Assyrians, on the other hand, built up an engine of warfare, a tremendous military machine, that, under powerful leaders, beat down and overthrew nations on every hand. Someone has compared Babylonia and Assyria to Greece and Rome respectively, as fostering and furthering different elements of national life and character.

The Civilization.— One of the marvels of these ancient peoples was their advancement in all that counts for civilization. Their governments were monarchical and well organized, with standing armies for their immediate protection. Their civil courts were provided with ample laws for the regulation of society and of trade. Their cities were advantageously built, and surrounded with walls of a magnitude sufficient to withstand any ordinary attack. Their schools were carefully fostered and occupied a first place in their peaceful life. They cultivated the arts with assiduity and attained a notable degree of perfection in some lines. Their architecture and sculpture, their language and literature, are marks of a people high in the scale of Oriental civilization. Of religious ritual and all its accompaniments and organization, we have a detailed description, which exhibits this as a favorite side of that early Sumerian and Semitic life. Their industry and trade activities were such as to place them in the front rank of commercial peoples. Their amusements and sports were of that adventurous and daring kind that bespeak the virility and strength of character found only among a hardy and vigorous people. Their political and commercial relations with their neighbors were such as mark an advanced stage in cordial international affairs. Their methods of warfare, and their treatment of their subjects, while often cruel and inhuman, were distinguished by a high grade of intelligence, and more than ordinary genius (cf. ASSYRIA).

Natural Resources.— The wasteness and barrenness of modern Babylonia give little intimation of its early resources. Its flora was quite varied and useful. Its plains were plentifully supplied with fruit trees of various kinds, such as fig-, olive-, date-, palm-, vine- and various nut-trees. On the mountain sides were found the oak, plane and pine trees of different varieties. By cultivation the land produced wheat, barley, sesame, millet, hemp and other cereals and articles of commerce. The date-palm was their universal utility article, for from it they seem to have manufactured honey, flour, vinegar, wine and raw material for wickerwork. The reed that grew with such luxuriance on the banks of the rivers and canals was utilized for a number of purposes. It served for building huts, weaving mats and for boat-building, and for layering mortar in the construction of walls.

The absence of stone and minerals in the basin of the valley was partially compensated for by their proximity to the mountains on the north and east, though clay bricks, sun-dried and burnt, were always their chief building material. When marble, alabaster, diorite or any of the precious metals were used they were brought either from their mountain borders or from distant lands. Stone was used for colossi, statues, wall decorations, bas-reliefs and some inscriptions. The precious metals were employed for making jewelry, ornaments, serviceable utensils, decorations on buildings and gates and for tablets upon which inscriptions were engraved.

The list of the fauna of the country is made quite complete by the pictures found on the walls of the old palaces and temples, and by the catalogues of names preserved in their literature. These reveal to us a great variety of valuable animals. Among them we find the lion, the favorite game hunted by kings, the panther, the wild ox, the fox, the wild boar, wild asses and camels — especially in later periods of history. There were also several kinds of gazelles and antelopes that played about on the border hills and mountains. Of domestic animals, there were the horse in later times, the ass, the camel, the cow, sheep, goat and dog. Of wild birds, the inscriptions mention most frequently the eagle and the owl; also the swallow, dove, raven, geese and other waterfowls.

Cities.— There is no more notable index of a great people than the number and magnitude of its great cities. Babylonia-Assyria, through the decipherment of the monuments, is seen to have been well dotted over with prosperous cities. Beginning in the south and proceeding northward, we find in that ancient day, Adab, Eridu, Ur, Erech, Larsa, Lagash, Nisin, Nippur, Borsippa, Babylon, Cutha, Sippar and Agade (!)— all famous cities in the Babylonian kingdoms and empires of four millenniums ago. The earliest civilization of that valley was centred in these cities, most of which seem to have been originally capitals of districts. There are other mounds in considerable quantity that have not been identified, but which doubtless cover still other cities that played an important rôle in the life of early Babylonia.

As we advance into the territory occupied by Assyria great cities present themselves in a formidable array. The ancient mother city of Assyria was Assur, located on the right bank of the Tigris, near the modern *Kalât Sherkât*, recently excavated by a German expedition. As we pass up the Tigris River of that day the next city of importance that one meets is Calah, or Nimrud, on the left bank of the river, just above the junction with the Tigris of the Upper Zab River. This was a palatial city, first unearthed by Layard, and then by Rassam, containing at least three royal palaces already mentioned. Off to the east of Calah, on the east bank of the Upper Zab, was Arbela, a city of minor importance. Nineveh, whose mounds stand on the eastern bank of the Tigris opposite the modern Mosul, was a very ancient city. The small stream or river *Khosr*, passing between the two great mounds Kuyunjik and Nebi Yunus, that represent the remains of

Nineveh, empties into the Tigris. Sargon II (722–705 B.C.) built for himself at Khorsabad, north of Nineveh, a veritable royal city, the most magnificent building of which was his palace, uncovered by Botta and Place. Its name, Dur-Sargina, "the wall or fortress of Sargon," designates sufficiently its significance for his reign. To the southeast of Nineveh we find another city of especial significance in the reign of Shalmaneser III (858–823 B.C.), Imgur-Bel, on the site of the modern *Balawat*.

Adjacent to this valley were such mighty cities and fortresses as Susa in Elam and Harran in upper Mesopotamia, and Carchemish, which the British have partially excavated within the past five years, with other cities on its western frontier — all evidence of the thrift and permanency of the civilization of 3,000 and 4,000 years ago.

Architecture.— The buildings of Babylonia-Assyria were modified architecturally, no doubt, by the character of the material accessible for their construction. Throughout this entire valley the absence of stone led to the use of clay bricks, sun- and kiln-dried, for building material. This, of course, necessitated a plainness of form that admitted of little exterior decoration. The walls were often built very thick, of sun-dried, with a veneer of kiln-dried, bricks. This veneer was a protection against the ravages of the weather and the depredations of robbers, who could readily dig through a thick wall of merely sun-dried bricks. The strength of a sun-dried brick wall was sometimes increased by inserting between the courses of bricks, layers of reeds. The entire structure was built on an artificially raised mound, primarily to lift the building above the danger of the overflowings of the rivers, but later apparently because of the age-long custom of placing it on an eminence. The entrances to the palaces and temples were usually guarded by great monolithic colossi, human-headed bulls or lions, standing on either side and facing outward. Within were courts of different sizes that served the royal personages or their attendants. In immediate connection with each palace or group of royal buildings, particularly in Babylonia, was the tower or temple. It was a structure that towered above everything else, and rose from its base to its summit in a series of stages, sometimes seven, or steps, by which one ascended. On the top of this massive pile one would find the image of the god held in particular reverence, or to whom the tower was dedicated. There are several remains of these sacred structures found in Babylonia today. Their ability to withstand the ravages of time is due to the hard burnt bricks with which they were constructed. The remains of the tower at Mugheir, the ancient "Ur of the Chaldees," was built, according to its present indication, upon a platform 20 feet above the plain; its base was a parallelogram about 200 feet by 135 feet.

One of the niceties of these constructions was their adaptation to the necessities and comforts of the people. There was an admirable system of drainage, of hydraulics in general, that embodied some of the best principles of modern sanitation. The arch contributed no little to the construction of some of the primitive royal buildings of the 20th century B.C. (cf. ASSYRIA).

Sculpture, Engraving, etc.— The most precious contents of the temples and palaces were the statues of the gods and kings, respectively. They are the best specimens of the sculpture of the Babylonian-Assyrian peoples. These works of art were often chiseled out of diorite, as those found by the French at Telloh; out of alabaster, as many of the giant colossi, or out of a basaltic rock, or black marble. The sculptors, even as far back as 3000 B.C., executed some wonderful work. Even more striking and complicated were their bas-reliefs, found so numerously on the walls of the palaces of the Assyrian kings. In this species of art there is often superb genius displayed in the introduction of many figures, of warriors, war-chariots, cavalry charges, battle scenes, sieges and captures of cities, and divinities of various grades. But in all these representations the modern student must not be disconcerted because of the lack of perspective. This is one of the characteristics of all early relief work and painting, and must be reckoned with in our study of those times.

Besides the large and imposing works of art, there were numerous small objects that occupied large attention and revealed some real artistic skill. There were the silver vases of the time of Entemena (about 2900 B.C.), ivory objects showing exquisite workmanship, gold ornaments, cylinder seals reaching back to 4000 B.C., of many precious stones whose intaglio work would be a credit to this day. The method of executing such fine work on the hardest of precious stones is still a puzzle to modern engravers. The decorations of Assyrian and Persian palaces include also painting, though of a kind that reveals more crudeness than the specimens of the engraver's art.

Literature.— The discoveries of the last three-quarters of a century have opened for us the doors to a new library of ancient Oriental literature. These clay and alabaster volumes cover a large range of subjects, and treat them in a manner entirely unique. The first that attracted attention was, of course, the immense amount of historical matter, found mainly in the ruins of Assyria. Another large element in these tablets, particularly in Babylonia, is the poetry, pure Semitic poetry, or interlineated with so-called Accadian or Sumerian poetry, whose character is determined by the presence of parallel members. This poetry contains hymns to the gods, penitential psalms, incantations, magical formulæ, and even epics of surprising strength. Examples of this poetry in Assyria were copied from Babylonian originals, as Assyria was notably weak in its literary ability. Then there are legends, mythology and popular treatments of technical subjects. We find also treatises that are geographical, biological, geological; tablets that are commercial in character, recording loans, deeds, rents and trades; long lists of matter that is purely linguistic, for it deals with signs and their values; a codified system of laws that touched almost every complication in the complexities of Babylonian life; letters, domestic and international, that reveal both the home customs of the nation and their foreign relationships and authority.

Myth and Legend.— The poems that are sometimes called epic, in the literature of Babylonia, are based upon events that are usually

termed mythical. The epic and mythical elements are so thoroughly commingled that the entire narrative may be termed mythological. The scenes depicted are those between gods and gods, and between gods and men, and other creatures. The most famous stories classified as mythology are the so-called creation epic, the epic of Gilgamesh, of the eleventh tablet or poem in the Babylonian story of the deluge. There are several legends and fragments of legends which have received careful study in recent years, whose matter is arranged on the customary Babylonian poetical plan. Some of these are, the descent of Ishtar into the world of departed spirits, the Namtar legend, the Adapa and Etana legends, and legends of various gods. Some of these entertaining literary stories take their place for real merit and interest beside the best legendary lore of ancient Greece. Their archæological value is often considerable, and their relation to the religious life of Babylonia-Assyria immeasurable.

Religion.— The primitive religion of Babylonia was doubtless the worship of the different powers of nature. These became personified and everything that took place in the world was simply the result of the action of some particular god, who stood above man in the scale of being, and executed all movements in the especial sphere where he was supreme. The representatives of these divinities on the monuments are seen sometimes to be men, and at other times to be part man and part beast and bird. Those in the form of men possessed attributes like, but far superior to, man. Since they represented different powers in nature, none of them was all-powerful. Their functions lay in special lines, and for these they were worshipped. In Assyria the gods as a whole were practically borrowed from Babylonia. But Asshur, the great divinity of Assyria, stood alone, unique in all the Mesopotamian pantheon and supreme in Assyria. The chief gods of Babylonia, those that were supreme in its pantheon, were three, Anu, the god of heaven; Bêl, the god of the earth, and Ea, the god of the abyss and of secret knowledge. These great three were followed by another triad, who regulated light and the weather, namely, Shamash, the sun-god, Sin, the moon-god, and Ramman or Adad, the weather-god. These six divinities were localized, in that each was the patron deity of some city. For example, Anu was the patron deity of Erech, Bêl of Nippur, Ea of Eridu, Shamash of Larsa and Sippar, and Sin of Ur (of the Chaldees). There is a long list of other gods and goddesses who were doubtless related to the two chief triads, but up to the present time this relationship in all cases cannot be determined. Slightly aside from the lists already named we find the great goddess Ishtar, one of whose feats is described in the legend, 'Descent of Ishtar.'

Worship.— The cities of Babylonia-Assyria were well supplied with temples in which the gods were devotedly and assiduously worshipped. Indeed, this worship was an essential element in the life of the Babylonians, to a greater extent than among the Assyrians. The temples were the most elaborate buildings of Babylonia, and were under the immediate direction of the priesthood, the most powerful class of men, next to the king, in the nation. Babylonian inscriptions, particularly, enumerate many temples in the chief cities that were dedicated to the patron deity of each several city. Each temple had an organization of official priests, whose duties included the preservation and propagation of the worship of the god of that temple, and the ritual and traditions thereof. The king was the great overlord or guardian of the temple, and spared no means to keep it in a thoroughly good state of preservation and to increase its popularity among his subjects. The support of the priesthood was provided for by revenues produced by the lands attached to the temple, or belonging thereto, supplemented by regular offerings. These priests, as those in Egypt, were the most influential men in the kingdom, for they controlled the religious life of the community and had no small part in the affairs of political and civil life. They were probably the best educated men in the nation, and by their learning filled the offices that required a somewhat broad training, such as scribes, historians and librarians.

The regular duties of the priests in connection with the temple service were (1) to officiate at all the regularly appointed services of the temple, including the monthly and annual set-feasts, and (2) to carry out the worshipful desires of any individual worshipper. The minutiæ of conditions regnant in temple service are voluminous and touch almost every condition of life. Some of the incantations and psalms, already referred to, preserve the petitions that must be recited by the suppliant. Other tablets enumerate the great variety of offerings that must be presented to the gods to secure their good-will and blessings. The multiplicity of such requirements easily kept an army of priests busy in the great temples of the principal cities of Babylonia-Assyria.

Sources of Babylonian-Assyrian History. — Before the excavations of the last 75 years in the ruins of Babylonia-Assyria, the two main sources of the history of the peoples and country in our theme were (1) the books of the Old Testament, and (2) the second-hand narratives of Berosus, Manetho and Josephus, with a few scattered statements and some questionable narrative in Greek and Roman writers. The discoveries in the ruins of Mesopotamia have now given us first-hand information of the best kind, narratives just as they were written down by the original scribes, and not copies made from age to age, as are the works above referred to. These clay, stone and metal records stretch not continuously as yet, but with breaks here and there, from at least 4000 B.C. down through the fall of Babylon before the army of Cyrus 538 B.C. Of course, they cannot be regarded as infallible, but are still for our purpose reasonably reliable. They give us, at least, a new panorama, of the most vivid kind, of the great nations that moved down the avenue of time in Babylonia for nearly 4,000 years.

Chronology.— The chronology of Babylonia must be described in part separately from that of Assyria. The early Babylonians reckoned events from some great calamity or occurrence, such as the destruction of a city, the dedication of a temple, or the opening of a new irrigating canal. Later down in the history they counted time by the years of a reigning king. There were several early dynasties in Babylonia whose succession of rulers is pretty well established. Such are those of Sumer,

Akkad, Nisin, Larsa and Babylon, whose beginnings fall approximately within 3000 to 2200 B.C. (cf. King, 'A History of Sumer and Akkad,' appendix 2, and 'A History of Babylon,' appendices). The 'List of Kings,' a list of the kings (not complete) of Babylon from about 2400 B.C. to 625 B.C., by dynasties, with the length of reign of each king and of each dynasty, and the so-called 'Babylonian Chronicle,' consisting of a record of events in Babylonia and Assyria from about 745 B.C., early in the reign of Nabonassar, to 669 B.C., the beginning year of the reign of Shamash-shum-ukin, are valuable documents. The Ptolemaic Canon, which has some reliable features, also begins with Nabonassar's reign. Besides these guides there are references here and there that both serve as checks and give us fixed points from which and toward which we may figure. One of the most striking is that mentioned by Nabonidus (555–538 B.C.) on one of his cylinder inscriptions. He there states that an inscription of Sargon which he found in the cornerstone of a temple had been deposited in its hiding place 3,200 years before his day, or about 3750 B.C. The more we find of ancient Babylonian facts the less probable the correctness of this date seems to be. It should be reduced about 1,100 years. Then there are chronological notes and hints, such as the statement that Burna-buriash lived 700 years after Hammurabi, that Marduk-nadin-akhe defeated Tiglathpileser I 418 years before Sennacherib conquered Babylon. Each such hint furnishes a valuable check on the whole chronological scheme, and aids the scholar in his construction of a valid and reliable list of rulers and events, even though for the present there are some wide and embarrassing gaps in the period covered by the early history of Babylonia.

Assyrian chronology follows a unique plan. It names the years after certain officers, termed eponyms, whose term of office extended over but one year. Lists of these eponyms have been found stretching from 893 B.C., during the reign of Adad-nirari III (911–889 B.C.) down to Assurbanipal (668–626 B.C.). On some of these lists we find merely the name of the eponym, on others there is found the name of the king in authority (in fact he usually was an eponym at some time during his reign), and some one chief event of each year. The succession of events between the limit years mentioned above is now positively known. To verify our calculation that these Assyrian records are correctly poised in time, we find that in the month of Sivan, year of the eponymy of Pur-Shagalti, there was a total eclipse of the sun in Nineveh. Astronomers have located this same eclipse on June 15, 763 B.C., thus giving us a fixed point for our calculations, and for settling specifically the dates of the entire Assyrian eponym lists.

The Historical Periods — Babylonia.—The history of Babylonia may be roughly divided into three periods: (1) That stretch of time reaching from the remotest recorded events down to the time of the consolidation of the city-kingdoms of Babylonia under Hammurabi at Babylon about 2130 B.C.; (2) the time included between Hammurabi's supremacy and 626 B.C., the death of Assurbanipal, last great king of Assyria, and the rise of Nabopolassar, first king of the new Babylonian kingdom; (3) beginning of Nabopolassar's reign (625 B.C.) to the fall of Babylon before Cyrus (538 B.C.).

First Period — Babylonia.— The beginnings of this period are enveloped in fog. Scattered fragments of antiquities and archaic inscriptions tell a broken tale of a very remote antiquity. Telloh, Nippur, Babylon and Susa have yielded to the excavator many evidences of an extreme antiquity and have put into our hands material for beginning to estimate some of the elements of such early civilizations. Some of the earliest kings were those who ruled over Sumer, Akkad, Nisin, Larsa, Erech, Lagash and Babylon, which occupied territory on either side of the Tigris and Euphrates rivers. Other kingdoms in this early period, about 3400 B.C., were Kish and Ur. The formal name of a governor in this earliest age was *patesi*. Lugal-zag-gi-si, however, King of Erech, apparently a Semitic name, designates himself "King of Erech, King of the world," but calls his father Ukush, "*patesi* of Gishban." Other kings of this very early period were Ur-Ninâ, the foundations of whose palace at Telloh are to be seen in the first illustration. Lagash seized and maintained authority, among others, over Gishban, Kish, Erech, Ur and Larsa. These events must have occurred about 3400 B.C.

About 2650 B.C., according to the corrected reckoning of Nabonidus, already mentioned, we find Sargon I in power, swaying his sceptre to the westward as far as the shores of the Mediterranean Sea. His son, Nâram-Sin, carried on the extensions of his father's kingdom until he included in his realm northern Syria, northern Arabia, Mesopotamia and Elam. He designates himself, therefore, "King of the four quarters of the world." There is a break in the records at this point. The next ruler, rather *patesi*, of Lagash apparently inaugurates a new reign, that enfolds within its borders the sway of all southeastern Babylonia, including also Elam. This *patesi* was Gudea, one of the most famous rulers of this valley, at about 2500 B.C. The accompanying cut represents one of his inscribed statues of black diorite found at Telloh, around which we find 366 lines of writing very artistically cut into this hard stone. On the lap of the statue there is a plan of a building, designed in exact proportions, revealing the standard of measurements current in Gudea's day. His numerous inscriptions tell us of his world-wide commercial activity, though his political power may not have included more than Elam outside of Babylonian territory. The power of the *patesis* of Lagash stretched over some time, and was a distinct force in the civilization of lower Babylonia. We have also the names of several kings of Ur, of Nisin, of Erech, of Larsa and of some smaller cities, whose exact location in the chain of history is not as yet fixed.

Second Period — Babylonia: 1st to 3d Dynasties. Beginning of Assyria, 2232–1181 B.C.— The isolated city-kingdoms of Babylonia had already existed for centuries, with here and there a ruler who had been able to gain the supremacy over one or more of his neighbors for a time. But the ma above all others who unified these scattered realms under his own sceptre, with Babylon as a centre, was Hammurabi, whose long reign of 55 years began about 2130 B.C. He greatly improved the

internal condition of his own country, both materially and politically, and carried his conquests to Elam, as had Sargon I, his predecessor by 500 years. Hammurabi's influence and power for the welfare of his subjects have been brought out anew by the discovery at Susa, in December 1901–January 1902, by M. J. de Morgan at the head of the French expedition, of a code of laws which had been compiled under his direction and orders. This remarkable document shows that Hammurabi's government was thoroughly regulated, for it provides laws now intact to the number of 243, to govern the complexities of commercial, social and official life. Successive kings of this 1st dynasty, founded about 2232 B.C. by Sumu-abu, are known as yet but slightly, though many contract tablets belonging to this period have been found.

The 2d dynasty in the 'List of Kings' began in 1927 B.C. and consists of 11 rulers, about whom we know nothing. It is thought that during their reign the Kassites made their way into Babylonia from the countries of Media and Elam and secured a hold on the throne.

The 3d dynasty in the 'List of Kings,' beginning at 1757 B.C., is made up of 36 kings, but only a few names at the beginning and at the close are preserved. The 'Synchronous History,' however, supplements this *lacuna* in some respects and gives us an idea of the relations of this dynasty to Assyria. In fact, early in this dynasty the former little colony of Assyria, which had migrated from Babylon some time about 2500–2300 B.C., rebelled against its mother-country, Babylon, and secured its independence. Its first king of whom we know the name was Bēl-Kapkapu (about 1900 B.C.), mentioned by Adad-nirari IV (810–781 B.C.) as an early king on the Assyrian throne. Ashur-bēl-nishishu is the first king about whom we know anything of value. He ruled about 1480 B.C. and was on friendly terms with Karaindashi, a king of the 3d Babylonian dynasty. Several successive Assyrian kings seem to have perpetuated this friendship, but jealousy and hostility sprung up and there were, repeatedly, clashes of arms, in which, on the whole, the young and vigorous Assyrian kingdom was victorious. One of the notable Assyrian kings of this period was Shalmaneser I, who ruled about 1300 B.C. His great campaigns against the territory northwest of Assyria are celebrated in the records of Assurnasirpal (884–858 B.C.).

Second Period — Babylonia: 4th to 7th Dynasties. Assyria, 1180–997 B.C.— We do not know the name of the founder of the 4th Babylonian dynasty. It came into being about 1180 B.C. The 'List of Kings' is, unfortunately, mutilated so that we have only portions of the names of the last three kings. The 'Synchronous History' fills part of the gap by giving some of the relations between Babylonia and Assyria during the life of this dynasty. These relations were hostile in some of its earlier years, when Nebuchadrezzar I (1140 B.C.) was on the throne, and the battle went against the Babylonians. Then Marduk-nadin-akhe, a Babylonian king, wrested victory from the Assyrians. Tiglathpileser I (1107 B.C.), King of Assyria, on the other hand, completely routed the same Babylonian king, captured a number of cities in north Babylonia, and even the city of Babylon itself. Succeeding kings of this Babylonian dynasty and of Assyria made treaties of peace, and for the time being ceased their wasteful warfare. Of all the Assyrian kings who reigned in the time of this Babylonian dynasty, Tiglathpileser I was the most vigorous, aggressive and successful. His example furnished an inspiration for all succeeding Assyrian rulers, and his conquests, related in full in his cylinder inscription, give us a fine specimen of early Assyrian historical writing.

The 5th Babylonian dynasty (about 1046–1024 B.C.) consisted of three kings whose full time of reigning was 21 years and five months. It has been called the "Sea-land" dynasty, because it is thought probable that the Chaldeans about the head of the Persian Gulf were the occupants of the throne. At least, it is probable that the country was in political confusion during the life of this dynasty.

The 6th dynasty (about 1024–1003 B.C.) like its predecessor, had just three kings, covering 20 years and three months, of whose acts very little is known.

A gap of about 100 years is found at this place in our sources, a part of which is attributed to an Elamite dynasty of one king who ruled six years.

Assyrian history likewise has a gap of more than 100 years (1070–950 B.C.). The 'Synchronous History' leaves us in the dark in this period.

Second Period — Babylonia: 8th Dynasty, 996–815 B.C. Assyria about 930–783 B.C.— The 8th dynasty of Babylon is supposed to have been native Babylonian, and occupied the throne from about 996 to ca. 815 B.C. The kings who ruled in Babylon during these 200 years fought a losing battle with the Assyrians, for in almost every clash the Assyrian was victorious. Though many of the names of the early kings of this dynasty are lost, we know those of the kings who waged war with Assyria during the larger portion of the life of the dynasty. With this dynasty the 'Synchronous History' closes.

The Assyrian records, the 'Eponym Canon,' begin in this period, at 893 B.C., and give us a continuous annual list down to 666 B.C. One of the most notable Assyrian kings of this period who have left us their records was Assurnasirpal (884–858 B.C.). This king was one of the most energetic and aggressive monarchs of Assyria. He established Assyria's authority in every direction, even to the coasts of the far-off Mediterranean Sea. His reign was vigorous, cruel and even barbaric. Locally, he built a great palace at Calah, and one at Nineveh, and restored the temple of Ishtar at the latter place. His son, Shalmaneser III (858–823 B.C.), still further extended the limits of his paternal realm by including lakes Van and Urumiyeh, in Armenia, and becoming protector of Babylon. To students of the Old Testament his reign assumes more than ordinary importance, for he was the first Assyrian king to come into contact with the Hebrew nation of Palestine. He mentions "Ahab of Israel" and "Jehu, son of Omri," both of whom became his subjects in the Westland. The accompanying illustration presents four of the five reliefs on one of the four sides of the famous Black Obelisk of Shalmaneser III. These four represent

the tribute paid by four foreign countries to the Assyrian king. The inscription over the first relief reads: "Tribute of Sûa of the land of Guzan, silver, gold"; over the second: "Tribute of Jehu, son of Omri, silver"; over the third: "Tribute of the land of Mutsri, double-humped dromedaries"; over the fourth: "Tribute of Merodach-abil-utsur of the land of the Sukhites." These four reliefs and inscriptions are only the first of four, the other three being found on the other three sides of the obelisk. Shalmaneser's son, Shamshi-Adad V (823–810 B.C.), succeeded him on the throne, and rescued the kingdom from a rebellion which had been stirred up by a brother. His only notable conquest was over Babylon under command of King Marduk-balatsu-ikbi.

The next king of Assyria was Adad-nirari IV (810–781 B.C.), son and successor of his father. His was a prosperous reign, reaching to Tyre, Sidon, Palestine and Philistia. Even Mari', king of Damascus, yielded submission to his sway.

As in Babylonia, so the next rulers in Assyria, three in number, amounted to little.

Assyrian Supremacy: Tiglathpileser IV, Babylonian Subjection.— Assyria's three lethargic rulers between 783 and 745 left no records that deserve mention. But their great successor, Tiglathpileser IV (745–727 B.C.), redeemed the ancient reputation of Assyria. This new king, although a usurper, revolutionized the policy and methods of the Assyrian empire. He pushed out the boundaries of Assyria farther than any predecessor on the throne. He completely subdued Syria, Palestine and Philistia. According to his own records he, more than any other Assyrian monarch, came into close contact with the Hebrews. The Hebrew monarchies were subservient to his sway. He mentions Menahem, Pekah and Hoshea, kings of the northern kingdom, and Uzziah and Ahaz, kings of the southern kingdom. To him also is to be attributed the policy of deportation of captives from a given district, and importation into that same district of peoples from distant districts, in order thereby to prevent the possibility of uprisings and rebellion. He also inaugurated a kind of local self-government, or provincial districts, as parts of his administrative policy, thus making a decided advance over the reigns of his predecessors.

The next Babylonian king of whom we know anything of consequence is Nabonassar (747–734 B.C.), mentioned in the Canon of Ptolemy, as well as in the 'List of Kings' and the 'Babylonian Chronicle.' But from this time down to the rise of the new Babylonian empire, Babylon was everywhere practically in the hands of Assyria, though there were some sanguinary struggles for the supremacy.

Sargon II, 722–705 B.C.— Tiglathpileser's successor was Shalmaneser V (727–722 B.C.), about whom we know little, as none of his inscriptions have been found. He blockaded Tyre for five years, and on the treacherous revolt of Hoshea, King of Samaria, laid siege to that city (724 B.C.) but did not take it. His successor was Sargon II, whose first act was the capture of Samaria in 722 and the deportation of the Jewish captives to various parts of his empire. He overthrew the combined forces of Elam and Babylon. In 717 he besieged and captured the city of Carchemish belonging to the Hittites. This Sargon was a master ruler, who not only subdued and held in subjection the peoples on the east coast of the Mediterranean Sea, but also with indefatigable skill put down Merodach-baladan of Babylon and his attempted conspiracy (cf. Isa. xxxix). Sargon's great home achievement was the construction of that colossal palace at Khorsabad, north-northeast of Nineveh, that was first discovered by Botta in 1842, as already described.

Sennacherib, 705–680 B.C.— Sargon II was assassinated in his new palace at Khorsabad in 705 B.C. and was succeeded by Sennacherib, his son. This vigorous ruler conducted at least three successful campaigns: (1) against the Westland: Syria, Phœnicia, and Palestine (701 B.C.), when he overran Judah, carried off 200,150 captives, threatened Jerusalem, making Hezekiah his subject, and met and, according to his own records, defeated an Egyptian army at Elteku; (2) in an expedition against Elam (693 B.C.) he was only partially successful, not quite reaching the capital, Susa; (3) in 689 he sacked, burned and practically destroyed the city of Babylon in revenge for the rebellious acts of its former ruler and inhabitants. Sennacherib removed the capital from Calah to Nineveh, and erected for himself a magnificent palace in that newly-made capital of the unified Assyrian-Babylonian empire. Other public works of an extensive nature, such as walls, gates, moats, arsenals and water supply, were the objects of his energy. Sennacherib was murdered by one of his sons, according to the 'Babylonian Chronicle,' and was succeeded by Esarhaddon, his son, who was not implicated in the conspiracy.

Esarhaddon, 680–668 B.C.; Assurbanipal, 668–626 B.C.— Sennacherib's son, Esarhaddon, made one of his residences at Babylon, carried on a successful warfare against the mountaineers to the north and northeast, and was the first Assyrian ruler to carry his conquests into Egypt. In 670 B.C. he crossed the frontier of that age-old land, took Memphis, and carried his arms as far as Thebes, driving the Ethiopian monarch of Egypt, Tirhaqa, back into his home land. He was the first king of Assyria who could add to his title, Egypt, Paturisi (biblical, "Pathros") and Kus (biblical, "Cush," "Ethiopia"). He associated with him on the throne his son Assurbanipal (669). In his list of 22 tribute-paying kings of the Westland we find "Manasseh of Judah." His successor was his son, Assurbanipal (the "Sardanapalus" of the Greeks, and "Osnappar" of Ezra iv, 10). Egypt had revolted about the time of the death of Esarhaddon, and thus necessitated the early attention of Assurbanipal to hold it. He was completely successful, driving back the rebel Tirhaqa and re-establishing his authority over the whole land. A second expedition was required again in 663 B.C., when the land was completely reconquered and Assyrian authority re-established. Very soon, however, Psammeticus of Egypt, with the help of foreign troops, threw off the yoke of Assyria. Assurbanipal's great work was the conquest of Babylon and his rebellious brother Shamash-shum-ukin in 647 B.C.; and, after several terrific battles, the crushing of the power of the Elamites in 640 B.C., by the capture and destruction of their great capital, Susa. These

colossal military achievements marked the culmination of Assyria's career, for henceforth there was a rapid decline (see ASSYRIA). Assurbanipal's notable contribution to the history of literature was his causing to be collected and copied for his royal library at Nineveh many of the most famous pieces of literature found in the libraries of Babylon. The last years of his reign are wrapped in obscurity.

Third Period — Babylonia: Rise of the Neo-Babylonian Empire 625 B.C. Fall of Assyria, 606 B.C.— Almost simultaneously with the death of Assurbanipal (626 B.C.) we find one of his former generals, Nabopolassar, a Chaldean by descent, securing the throne of Babylon for himself (625–605 B.C.). While he was developing and extending his influence and grasp over the territory that was naturally tributary to Babylon, momentous events were occurring in the north country, in and about Assyria. The growing Median power threatened its very life. One son of Assurbanipal, Assur-etil-ilâni and possibly a brother, Sin-shar-ishkun, occupied the Assyrian throne, the former about six and the latter about seven years. The waves of the Umman-Manda, peoples to the north and northeast of Nineveh, were rolling over the mountains of eastern Armenia and northern Media. According to an inscription of Nabonidus, written about 553 B.C., these mountaineers, in conjunction with the Medes, finally succeeded in overwhelming Nineveh, the last hiding-place of the Assyrian tyrant and oppressor, in 606 B.C.; this was done probably with the direct or indirect support of Nabopolassar of Babylon.

Nebuchadrezzar II, 604–561 B.C.— Simultaneously with the fall of Nineveh we find an Egyptian army under Necho encamped in northern Syria, in full possession of the eastern coast of the Mediterranean Sea. In a crushing defeat Nebuchadrezzar overthrew and pursued the Egyptian invaders, and secured that territory for the new Babylonian empire. Within the 43 years of his reign, Nebuchadrezzar made Babylon the up-to-that-time greatest of empires. His authority extended, on biblical evidence, even into Egypt, and his activities were something phenomenal. In fact, the larger part of his inscriptions already found are devoted to his immense building projects, including temples, palaces, streets, embankments and walls. Babylon was built in great magnificence, and in every important aspect did credit to the enterprise and genius of Babylonia's greatest monarch. His own records thus far found do not give us any account of his dealings with the Jews, either at Jerusalem or those in exile — described in the Old Testament. After a long and prosperous reign he was succeeded on the throne by his son, Evil-Merodach. This king was assassinated after a reign of two years (561–559 B.C.), by Neriglissar, his brother-in-law. This usurper ruled four years (559–555 B.C.), and spent most of his time, according to his inscriptions, in building operations. At his death his son, Labashi-Marduk, not yet of age, succeeded him, but fell under the assassin's dagger within nine months.

Nabonidus, 555–538 B.C.— By some machinations of the priesthood, apparently, the new king, Nabonidus, was a native Babylonian and not a Chaldean as was the dynasty of Nabopolassar. He was an enthusiastic religionist and antiquarian. He built and rebuilt many temples in the principal cities of his kingdom. He was the discoverer, in the foundations of a temple, as already stated, of an inscription of Sargon I, which had been placed there 3,200 years before his day, making the date of said Sargon, on his calculation, about 3750 B.C., or, as corrected, 2650 B.C. Nabonidus' enthusiasm carried him too far, for he attempted to centralize in Babylon the religion of the kingdom. In doing this he alienated the priesthood, and even aroused their active opposition. For throughout the history of Babylonia each city had its own patron deity, to whom its temple was dedicated and its people devoted. The images and shrines of these various divinities were collected in Babylon. This act, with others of similar offense to the priests, paved the way for his downfall before a mightier power.

Cyrus, 538–529 B.C.— Cyrus, an Elamite and Persian by descent, began an active career as a conqueror in 558 B.C. He conquered successively the Medes under Astyages (550 B.C.), Crœsus and Asia Minor (547 B.C.), and then moved against Nabonidus, who had allied himself against this new conqueror. The Babylonian army was probably under the command of Nabonidus' son, Belshazzar. Suffering a defeat at Opis, the army of Babylon later scarcely offered resistance. Cyrus marched, almost without further opposition, to the gates of the capital city. The outraged priesthood and citizens, in open defiance of their own king, flung open the gates and welcomed the new and liberal conqueror to authority over them. Cyrus restored the gods to their cities and shrines, and permitted enforced exiles to return to their native places and lands. Besides, he became one of the ardent worshippers of the gods of the land and established himself as a liberty-loving, people-serving potentate.

The fall of Babylon before the advance of Cyrus meant the fall of Semitic sway in Babylonia, and the rise of Aryan power. The cuneiform tongue served the purpose of a language in Babylonia for long years after this revolution. In fact, throughout the Persian and Greek periods, this same language was used in Babylonia, particularly in writing contract tablets. There are some inscriptions dating from the Parthian era, due doubtless to the enthusiastic support of the priesthood of those times. Thus for nearly or quite 4,000 years the cuneiform language was the vehicle of expression for the peoples of Babylonia.

Bibliography.— The literature on Babylonia-Assyria has already become voluminous. Consequently, in a limited bibliography, only selections will be given. These will cover the following departments of study:

(1) **Explorations and Discoveries.**— These include the early works of C. J. Rich, J. E. Taylor, A. H. Layard, P. E. Botta, Felix Jones, W. K. Loftus and J. Oppert. Since 1870 the most important works are those of George Smith, H. Rassam, E. de Sarzec, John P. Peters, H. V. Hilprecht and M. J. de Morgan, R. Zehnpfund and R. Koldewey, freely cited in all works on discoveries in those lands; 'Mitteilungen de deutschen Orient-Gesellschaft' (1898–).

(2) **Inscriptions and Texts.**— Cuneiform texts very early began to be published. The first notable publication was Rawlinson's text

and translation of the Behistun Inscription (in the *Journal of the Royal Asiatic Society*, Vol. X, 1847). Botta, Layard and Oppert also published inscriptions as a result of their explorations and excavations. H. C. Rawlinson edited (1861–84) for the trustees of the British Museum five standard volumes of texts under the title 'Cuneiform Inscriptions of Western Asia.' Many minor series have appeared since that date, such as 'Assyriologische Bibliothek' (1881–, edited by Delitzsch and Haupt); 'Babylonian Expedition of the University of Pennsylvania'(edited by H. V. Hilprecht, many volumes, 1893–); Cuneiform Texts in the British Museum' (34 parts have appeared to 1917), by officials of that museum; 'Découvertes en Chaldée' (1884–1913), by E. de Sarzec; 14 volumes of 'Assyrian-Babylonian Letters' (1892–1914), by R. F. Harper, and 'Mémoires de M. J. de Morgan' at Susa, in which V. Scheil has edited notable Elamite-Anzanite texts, including the Code of Hammurabi; Ira M. Price, 'The Great Cylinders A and B of Gudea' (1899). A series of valuable texts (13 parts in 1914) entitled 'Vorderasiatische Schriftdenkmäler der Königlichen Museen zu Berlin' edited by Frdr. Delitzsch, 1907–); A. T. Clay, 'Babylonian Records in the Library of J. Pierpont Morgan,' (Parts I and II, 1912, 1913); G. A. Barton, 'Haverford Library Collection of Cuneiform Tablets' (Parts I, II, III, 1905–14); Mary I. Hussey, 'Sumerian Tablets in the Harvard Semitic Museum' (Part I, 1912; Part II, 1914); A. T. Clay, 'Miscellaneous Inscriptions in the Yale Babylonian Collection: Babylonian Texts' (Vol. I, 1915). In addition to these there are scores of texts of lesser value to the student.

(3) Equipment for Study of the Language.— The former dearth in this field has been largely supplied by Frdr. Delitzsch. His 'Assyrische Lesestücke' (5th ed.); his 'Assyrische Grammatik' (2d ed., 1906); B. Meissner, 'Kurzgefasste assyrische Grammatik' (1907); Delitzsch, 'Assyrisches Wörterbuch' (1887—), and 'Assyrisches Handwörterbuch' (1896), constitute a fairly good outfit. Other works helpful in the same line are Brünnow's 'Classified List of Cuneiform Ideographs' (1889); Muss-Arnolt's 'Concise Dictionary of the Assyrian Language' (1894–1905); L. W. King and H. Winckler have likewise contributed liberally to this department of work. The new field of Sumerian study, so closely interwoven with Babylonian-Assyrian, has also acquired new equipment. We now have S. Langdon, 'A Sumerian Grammar and Chrestomathy' (1911); Frdr. Delitzsch, 'Sumerische Grammatik' (1914); 'Kleine sumerische Sprachlehre' (1914), and 'Sumerisches Glossar' (1914).

(4) Translations, Commentaries, etc.— There is a long list of this material, but some of the most useful for modern students are 'Keilinschriftliche Bibliothek' (1889–, edited by E. Schrader); 'Assyrian and Babylonian Literature' (1901, edited by R. F. Harper); 'Zeitschrift für Assyriologie' (1886–, edited by C. Bezold); several volumes in Delitzsch and Haupt's 'Assyriologische Bibliothek' and 'Beiträge zur Assyriologie' (1889—); A. T. Clay, 'Personal Names of the Cassite Period' (Yale Oriental Series, Vol. I, 1912); 'Vorderasiatische Bibliothek' (1906–, edited by A. Jeremais, H. Winckler, and Otto Weber); and many valuable volumes by L. W. King and R. C. Thompson, published by the British Museum; and other volumes issued by C. H. W. Johns of Cambridge.

(5) Learning, Religion, Art.— Selections only: F. Hommel, 'Die Vorsemitische Kulturen in Ægypten und Babylonien' (1883); A. H. Sayce, 'Religion of the Ancient Babylonians' (Hibbert Lectures, 1887); 'Higher Criticism and the Monuments' (1893, several editions later); A. Jeremias, 'Babylonische-assyrische Vorstellungen vom Leben nach dem Tode' (1887); C. P. Tiele, 'Geschichte d. ægyptischen u. d. babyl.-assyr. Religion' (1895); M. Jastrow, Jr., 'Religion of Babylonia and Assyria' (1898, newly revised and greatly enlarged ed., 1905–12, in German); H. Zimmern, 'Beiträge zur Kenntniss der babylonischen Religion' (1901); Perrot and Chipiez, 'Histoire de l'art dans l'antiquité' (Vol. II) 'Chaldée et Assyrie' (1884); 'Collection de Clercq' (1888–); Virolleaud, 'L'Astrologie Chaldéenne' (1905–); older works, such as those of Botta, Layard and Place, are of value chiefly for their illustrations.

(6) History and Archæology.— Some of the most recent works superseding the large work of George Rawlinson are F. Hommel, 'Geschichte Babyloniens u. Assyriens' (1885–89); C. P. Tiele, 'Babyl.-Assyrische Geschichte' (1886–88); H. Winckler, 'Geschichte Babyl. u. Assyriens' (1892); J. F. McCurdy, 'History, Prophecy and the Monuments' (1894–1901); H. R. Hall, 'Ancient History of the Near East' (1913); R. W. Rogers, 'History of Babylonia and Assyria' (6th ed., 1915); L. W. King, 'A History of Sumer and Akkad' (1910), and 'A History of Babylon' (1915); Schrader-Winckler-Zimmern, 'Die Keilinschriften und das Alte Testament' (3te Auflage, 1901–03); A. Jeremias, 'Das Alte Testament im Lichte des alten Orients' (2d ed., 1906); 'Handbuch der altorientalischen Geisteskultur' (1913); M. Jastrow, Jr., 'The Civilization of Babylonia and Assyria' (1915).

Further bibliographical material may be found in the periodicals devoted to Assyriology, *Zeitschrift für Assyriologie*, the *American Journal of Semitic Languages and Literatures*, *Orientalische Bibliographie*, *Orientalistische Literaturzeitung* (1898–); *Revue d'Assyriologie et d'Archéologie Orientale* (1884–); also in the comprehensive articles on «Assyria» and «Babylonia» by Hommel and King in Hastings' 'Dictionary of the Bible' and Cheyne's 'Encyclopædia Biblica' respectively.

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AST, äst, **Georg Anton Friedrich**, German scholar and philosophical writer: b. Gotha, 29 Dec. 1778; d. Munich, 31 Oct. 1841. In 1805 he was appointed to the chair of classical literature at Landshut and in 1826 accepted an appointment to the same chair in the University of Munich. Among his best known publications are: 'Handbuch der Aesthetik' (1805); 'Grundriss der Geschichte der Philosophie' (1807); 'Wissenschaftliche Darstellung der Grammatik, Hermeneutik und Kritik' (1808); 'Platos Leben und Schriften' (1816). He also published an edition of the works of Plato in

11 volumes with a Latin translation and a commentary (1810–32).

ASTACIDÆ, the family of decapod *Crustacea* containing the crayfishes (q.v.). It is divided by some into two families — *Astacidæ* of the northern hemisphere, and *Parastacidæ* of the southern. "There can be no doubt," says W. T. Calman ('Life of Crustacea,' 1911), "that the two families have been derived from a common stock of marine, lobster-like animals, and it is reasonable to suppose that two branches of this stock became independently adapted to a fresh-water habitat in the North and in the South."

ASTACUS, a genus of decapod *Crustaceans* of the family *Astacidæ,* including the *A. marinus,* or lobster, and the *A. fluviatilis,* or crayfish. The species *A. fluviatilis* contain the crayfishes of Europe, and also those of the Pacific States of the United States, while those found along the Atlantic coast belong to the species *Cambarus.*

ASTARA, a port of Russian Transcaucasia, government of Baku on the Caspian in lat. 38° 27′ N., and long. 48° 53′ E. on a river of the same name which forms the frontier between Persia and Russia. Russian merchandise is landed there and forwarded to Azerbáiján and Tabriz via Ardebil.

ASTARABAD, Persia, province bounded on the north by the Caspian Sea and Russian Transcaspian, south by the Elburz Mountains, west by Mazandaran, and east by Kharasan. The country is mountainous, possesses extensive forests, fertile valleys, producing rice, wheat and other grains in abundance, and rich pasturages. The soil is exceedingly productive owing to the abundance of water which irrigates and fertilizes it. It is, however, a prey to the ravages of disease, principally malarial fevers due to the extensive swamps formed by waters stagnating in the forests, and to the frequent incursions of the Turkomans. The inhabitants, nevertheless, are a strong and athletic race. The population is about 100,000. Astarabad, the capital, is situated on the Astar, has post and telegraph offices, and a population of about 10,000.

ASTARTE, a genus of bivalve mollusks belonging to the family *Cyprinidæ.* They have 2–2 hinge teeth and are suborbicular, compressed, thick, smooth or concentrically furrowed shells. Tate estimated the recent species known at 20 and the fossil at 285. The former belong to the temperate and Arctic zones, and the latter to the rocks from the carboniferous formation upward.

ASTARTE, ȧs-tär'tē, a character in Byron's play, 'Manfred.' The hero guiltily falls in love with her, and in the second act her shadow appears to him in a denunciatory attitude.

ASTARTE, ȧs-tär-tē, or **ASHTORETH,** a Syrian goddess, probably identical with the *Semele* of the Greeks, and the Ashtaroth of the Hebrews, and worshipped also by the Phœnicians and Carthaginians, being regarded by some as the original of the Greek goddess *Aphrodite* (*Venus*). She was the moon-goddess, or goddess of the heavens, and appears also to have been worshipped as the goddess of fruitfulness. In the Old Testament, Astarte is frequently mentioned as the goddess of the Sidonians (see 1 Kings xi, 5–33; 2 Kings xxiii, 13), but the form of her name seems to have been perverted, to her original name of Ashtart being infixed the vowels of Bosheth, or "shame," and we find her there called Ashtorath. In 1 Samuel xxxi, 10, Astarte is again mentioned, as is also the fact that a temple was built to her at Ashkelon. There were also temples at Citium in Cyprus, at Eryx in Sicily and in Carthage. The Syrians also built a famous temple to her at Hierapolis, at Tyre and at Sidon. She is probably identical with the Assyrian goddess Ishtar, or Istar, the "Lady," the "Queen of the Gods" or the virgin goddess of death and war, who enforces strict chastity upon her priests and priestesses. Astarte is represented in various forms, but more usually with four wings, the two uppermost representing the horns of the moon and having on her head a pointed cap and a white dove in her hand. Others represent her as a naked female figure, short and stout and the hands holding the breasts. She is also represented in Phœnicia as a cow.

ASTATIC (as-tat'ĭk) **NEEDLE** (Greek, "unstable"), in physics, a magnetic needle whose tendency to set itself in the magnetic meridian has been nearly or quite neutralized in some way, so that while the needle retains its full magnetic power it will remain indifferently in any position, even when quite free to turn. A magnetic needle may be made astatic in various ways; for example, by disposing magnets in the vicinity of the needle in such a way that their field of force opposes and neutralizes the earth's field. A commoner method is to make use of a pair of needles of equal size and equal magnetic strength, securing them together, one above the other, by a light, rigid connection, so that their lengths shall be parallel and their poles turned in opposite directions. If the conditions here assumed are fulfilled rigorously the system will have no directive tendency whatever. In practice it is quite possible to secure an adjustment so good that the directive tendency is masked by the torsional force of the suspending fibre. Astatic needles are used in the construction of delicate galvanometers, the coil conveying the current passing around only one of the needles of the system or around both of them in opposite directions. The full magnetic moment of the current is thus obtained, while the directive action of the earth's field remains practically zero and the motion of the needle is opposed only by the torsion of the suspension. See GALVANOMETER.

ASTEN, äs'tĕn, **Friedrich Emil von,** German astronomer: b. Cologne 1842; d. 1878. From 1870 he was employed at the Imperial Russian Observatory at Pulkowa. He will be best remembered for his work upon Encke's comet, the results of which were published in 1877, and included an elaborate discussion of all the appearances of this interesting body from 1819 to 1875.

ASTER, a genus of plants belonging to the family *Asteraceæ,* and comprehending several hundred species, mostly natives of North America, although some of the species are found over most regions of the globe. The name is derived from the Greek *aster,* a star,

and is due to the fact that the heads of the flowers bear some resemblance to stars. The species are mostly herbaceous plants. Large as the genus is, it contains no species of any great utility in the arts, but many are cultivated as ornamental plants. The most beautiful species among those which are natives of Europe are *A. alpinus, A. amellus* and *A. pyreneaus*, and among those of America, *A. puniceus, A. multiflorus* and *A. novæ-angliæ*. The China aster (*Callistephus chinensis*), introduced from China upward of a hundred years ago, is a well-known annual, growing to a height of from 12 to 18 inches and bearing an abundance of large and beautiful flowers, exhibiting in the numerous varieties every hue except yellow and a great diversity of marking. This plant lends itself readily to culture and florists are constantly adding new varieties to a stock that already numbers nearly 300. The French call this species Reine Marguerite. The chrysanthemum and peony flowered varieties are particularly worthy of cultivation for the size, color and abundance of their flowers. From the lateness of the season in which they bloom some species of aster have obtained the name in England of Christmas daisy.

ASTER, ăs'tẽr, **Ernst Ludwig von,** German military engineer: b. Dresden 5 Oct. 1778; d. Berlin, 10 Feb. 1855. His first service was in the Saxon army. It was in 1810, as an officer in this army, that he submitted his plans, subsequently accepted, for the fortification of Torgau to Napoleon. Subsequently he entered the Russian service and soon after 1815 the Prussian. While in the last service he undertook the fortification of Coblentz and Ehrenbreitstein, and in 1842 was appointed general and inspector of all the Prussian fortresses.

ASTERISK ("a little star"), a sign or symbol (*) used in writing and printing, as a reference to a note at the bottom or on the margin of the page. The obelisk or dagger (†) and many other marks are similarly employed; but when there are several references on the same page, it is now common to use the numerals 1, 2, 3, etc. The asterisk often marks the omission of words or sentences, or it distinguishes words as conjectural or obscure, or it may be used merely as a typographical mark for any specified purpose.

ASTERISM, a property possessed by a few minerals of exhibiting star-like rays. It is due either to reflection of light from twinning lamellæ or minute enclosed tubes, as in the case of star-sapphire (q.v.), star-ruby and star-quartz (q.v.), or to the regular arrangement of minute enclosed crystals as seen by transmitted light in the case of some phlogopite or star-mica.

ASTEROI'DEA, an order of *echinodermata*. See STARFISH.

ASTEROIDS, a group of small planetary bodies known also as minor planets which revolve round the sun between the orbits of Mars and Jupiter. The most remarkable feature of these bodies is that they occupy a vacant place in the solar system in which a planet would naturally belong. Between the orbit of Mars, the fourth planet in order, and that of Jupiter, the fifth, there is a space more than double the radius of the orbit of Mars. This gap was noticed from the time that the distances of the planets were laid down by Kepler. It was long suspected that a planet would be found occupying such space and an organized effort was made to discover it. The discovery of a planet which was supposed to be the long-sought body was made by Piazzi at Palermo on the first day of the 19th century. To the great surprise of astronomers three other planets were found in the course of the next six years to be revolving in the same region. The smallness of the four bodies gave rise to the celebrated hypothesis of Olbers that these bodies were the fragments of a single planet which had been disrupted by some cataclysm. Some 40 years elapsed when in 1846 a fifth asteroid was discovered. Others soon followed. More powerful telescopes were applied to the search, a thorough system was introduced and in this way the number known went on increasing until it mounted into the hundreds, and now a dozen or more are frequently added to the list in a single year.

When photography was applied to form a permanent picture of the stars in the sky, it was found that this method was the easiest by which discoveries of these objects could be made. Whatever method may be used, the difficulty of discovering an asteroid arises from the fact that it is impossible to distinguish such a body from a fixed star by its mere aspect. It can be detected only by its motion among the stars and therefore requires that the same body should be observed at different times. But a photograph enables the motion to be detected in a very simple way, as follows:

If a telescope, mounted so as to serve as a camera, is pointed at a given region of the sky for half an hour or more the images of the stars which fall on the plate remain immovable, and these bodies are photographed as simple points of light. But if an asteroid is in the field, its motion during the exposure is quite appreciable; and its picture appears as a short line, equal in length to the amount of motion during the exposure of the plate, which can be detected at sight. A decided improvement to this photographic method has been recently devised which consists in subjecting the plate to a slight, uniform, sidewise motion equal to that of the average asteroid in the part of the sky under examination. The stars are thus photographed upon the plate as trails while the asteroid appears as a very much shorter trail or as a point of light; its image is thus rendered far more intense than if it were allowed to trail, and numerous asteroids have been thus discovered which would have been far too faint to be detected by the older method. During the last 10 years the number discovered has carried the total list up to more than 800, a number so great that it is almost impossible to compute the orbits or motions or even to find separate and appropriate names for the bodies.

The asteroids are distinguished from the major planets by several distinct and interesting features. One of these concerns their orbits. While the major planets, with the exception of Mercury, all move in nearly circular orbits, the orbits of the asteroids are, in the general average, markedly eccentric.

In some cases the asteroid is twice as far from the sun at aphelion as at perihelion. One result of this is that they appear several times brighter when seen in opposition at perihelion than at aphelion. The inclination of the orbits is also frequently very large. That of Pallas, one of the original four, is inclined no less than 34° to the elliptic. The result of this is that many of these bodies wander far outside of the limits of the Zodiac; indeed, in many cases they are seen north of the zenith in our latitudes when nearest the earth.

The size and mass of the asteroids do not admit of very accurate definition, for the reason that, with rare exceptions, they are seen in the telescopes only as points of light. Barnard has, however, succeeded in measuring the apparent diameter of the first four, three of which are probably the largest of the group, with the great Lick telescope. The results are:

	Miles
Diameter of Ceres	488
Diameter of Pallas	304
Diameter of Vesta	248
Diameter of Juno	118

Only the largest shows a diameter exceeding one-twentieth that of the earth, and all the others are much smaller than this. Judging from the amount of light they reflect very few of them are 100 miles in diameter and most of those known may not exceed 10 or 12 miles in extent. Indeed, we have reason to believe that as we take smaller diameters the number increases without any limit. The same remark might apply in a still greater extent to the masses. The latter are so small that the attraction of the whole mass of all the asteroids does not produce any effect that has yet been observed upon any planet or comet.

Of the total number of these bodies it is hardly possible to form any estimate, because the more powerful the means of research the more are found. We can hardly be astray in supposing that thousands exist, and if we include those that must forever remain invisible to us, the number must be countless. Yet they are all so minute that the total mass cannot be as great as that of the planet Mercury.

The hypothesis already mentioned, that these bodies are fragments of a great planet, has been effectually disproved by modern research. Apart from the impossibility of an explosion which would rend a planet, we have the fact that in the event of a disruption all the orbits would pass through a single point. It is true that this coincidence would not continue indefinitely, because the orbits would change their positions by the attraction of the other planets; but their sizes are found to be such that they could not originally have passed through any single point. It is more probable that the asteroids are merely scattered meteoric material which formed a small part of the original nebula from which the solar system was developed but which was prevented from becoming aggregated into a single world, probably by the great disturbances produced by the attraction of the nearby planet, Jupiter. There is a curious grouping of the orbits which seems to have some connection with the origin of the whole collection. Many years ago it was noticed by Kirkwood that, if the orbits were arranged according to their mean distance from the sun, there would be gaps in the series at those points where the time of revolution was commensurable with the period of Jupiter. For example, there are no known asteroids having a period one-third that of Jupiter, or one-half or two-fifths, although there are plenty of orbits within and outside these peculiar limiting values. The subsequent discovery of hundreds of these bodies has led to a slight modification of this law. The orbits not only seem to avoid these peculiar values, but to accumulate midway between them. To get an idea of the results suppose that every orbit stretched into a circle of a radius equal to its mean distance. Then treating these orbits as hoops, suppose that we arrange them all round on one centre. We should then find that the rings are divisible into four, five or six nearly distinct groups with vacant spaces between them. The explanation seems to be that the material which might have been originally in these vacant zones could not long remain there, for the accumulating, periodic, planetary perturbations would speedily force it nearer or farther away from the sun.

Perhaps the most remarkable of the asteroids was one discovered in 1898. Some of its peculiarities have excited great attention on the part of the astronomical world. The orbits of all the other known asteroids are contained between the orbits of Mars and Jupiter, no known orbits approaching very near either of these planets. But, in the summer of 1898, Witt, of Berlin, found an asteroid which at perihelion came far inside the orbit of Mars, indeed within 13,500,000 miles of the orbit of the earth. Its orbit was found to be extremely eccentric and, which was more curious, it was interlinked with that of Mars, so that if the orbits were rings, they would have passed through each other and hung together like two links. What gives this planet especial interest is that on these rare occasions when it comes nearest to the earth its parallax can be measured with greater precision than that of any of the other planets. It therefore affords us the best possible method of directly measuring the solar system; but, most unfortunately, it is only at intervals of 37 years that the nearest approaches occur. What is most tantalizing, is that only six years before it was discovered, it is known to have passed at nearly the least distance from the earth, but it was then unseen by human eye. It was found to have been photographed a great number of times at the Harvard Observatory; but among the hundreds of stars whose images were found on the plate, its image was completely lost after the discovery in 1898. It was recognized through the determination of its orbit which made possible the computation of its position in the heavens at former positions.

In the winter of 1900–01 there was as close an approach to the earth as would occur during the next 30 years, although the distance was then but little less than 30,000,000 miles. A co-operative effort was made to measure the parallax on this occasion. No less than 58 observatories took part, some making photographic and others micrometric measures of the planet, while many others co-operated by making meridian observations of reference stars. When the great mass of observational material was finally reduced, there resulted for the solar

parallax the value, 8."806 with a probable error of but 0."004. This is the most accurate value thus far determined by any method. The next closest approach of Eros to the earth will occur in 1931 when the distance apart of the planets will be less than half as great as it was at the time of their closest approach in 1900. Soon after this date, therefore, the value of the fundamental unit of astronomy will become known with a far greater accuracy.

A curious property of this most remarkable body is a periodical variation in its light which was noticed during the opposition of 1900–01. It was found to go through a series of changes in the course of five hours quite similar to those of a variable star. The period was found to be two and one-half hours, but possibly the same brightness was not reproduced except in a period of five hours. It was yet more curious that these variations seemed to have nearly or quite ceased at the next opposition.

SIMON NEWCOMB.

Revised by ERIC DOOLITTLE, *Professor of Astronomy and Director Flower Astronomical Observatory.*

ASTEROL'EPIS, a genus of ganoid fishes named on account of the starry color of its scales. A bone of a species belonging to this genus, found at Stromness, the capital of Orkney, suggested to Hugh Miller the writing of his beautiful volume entitled 'Footprints of the Creator; or, the Asterolepis of Stromness.' It was an elaborate argument against the development hypothesis. According to that hypothesis, the first species of any class appearing on the scene should be low in organization, and probably small in size. Mr. Miller showed that the asterolepis was large in size and high in organization, and yet it was at that time believed to be the oldest fossil vertebrate found in Scotland. His argument was subsequently weakened by the discovery that the Stromness rocks were less ancient than the Forfarshire beds, containing cephalaspis and other fish genera subsequently discovered, mostly of small size, though not of low organization.

AS'TEROPH'YLLITES, fossil plant remains, which with Annularia and Sphenophyllum form the leaves of the group Calamites of the Devonian, Carboniferous and Permian periods.

ASTHENIA, a disease of poultry, known in the United States as «going light.» The treatment is purgation and tonics. Also a symptom of many disorders of the body characterized by muscular weakness. Such muscular weakness is normal in fatigue, but such fatigue may be greatly exaggerated when toxic factors reduce the muscular power. Such reduction is frequent in disease of the adrenal system. See ADRENALS.

ASTHENOPIA, or **WEAK SIGHT,** common affection of the eye, due immediately to muscular fatigue. Its chief symptoms are pain in and around the eyes or headache, which is increased by use of the eyes on near objects and in artificial light. It occurs most frequently in persons of weakened constitution and especially neurasthenics. A prolonged strain may have serious results, often causing temporary dimness of vision, double vision, and otherwise may cause general sight disorders. See EYE, DISEASES OF.

ASTHMA, as'ma, or az'ma, a disorder of respiration characterized by more or less severe paroxysms of difficult breathing accompanied by coughing, wheezing and, in severe attacks, by slight asphyxia. The attacks usually come on suddenly, last from a few minutes to many hours and are generally followed by complete relief, and recur at more or less frequent intervals. They are characterized by extreme difficulty both in inspiration and expiration. Numerous theories have been advanced in regard to the causation of the disease, but the symptoms are best explained by ascribing it to a spasmodic contraction of the muscles of the bronchioles (small bronchial tubes). The underlying causes of this are manifold, but there are a few which are of special importance and attention to these may help greatly in avoiding or lessening the severity of the attack. The predisposition of asthmatics is usually a hypersensitive nervous system or an irritable nasal mucous membrane, or the attack may be started by some external irritant. Asthma occurs oftener in men than in women, and frequently in children, especially after bronchitis, measles or whooping cough. It may occur in any climate or locality, in the mountains or at the seashore. A change of air or of locality is an important factor in some cases. The affection is most common during spring and autumn, which may be due to the larger amount of dust and pollen in the air at those seasons. The malady is oftentimes inherited, passing from one generation to another; statistics show this to be true in 50 per cent of the cases. Gout and rheumatism are causes frequently associated with the disease. Among reflex causes are constipation, indigestion, uterine disturbances, nasal catarrh and growths of the nose pressing upon the septum higher up. Touching certain spots in the nose causes some persons to sneeze and may excite a paroxysm; pregnancy has been recognized as causing asthma in some cases. Disorders of the heart and kidneys produce respectively cardiac and renal asthma. Dust, fog, pollen, sulphur from matches, emanations from horses, cats, dogs, etc., fumes from certain chemicals are all external irritants which may cause an attack in a person constitutionally predisposed. Physical excitement, anger, grief, etc., are also causes. Asthma is never due to disease of the lungs and is never directly associated with tuberculosis. Sometimes cases occur with no apparent cause to account for the onset of the symptoms.

The symptoms may come on at any time during the day or the night, but in the majority of cases the attack begins during the night, sometimes abruptly but often by degrees. A sense of marked fatigue, sneezing or heaviness in the pit of the stomach are signs which the patient soon learns to recognize as the forerunners of an approaching attack. He is aroused from sleep after midnight with a choking sensation. In some cases this condition increases slowly, not becoming acute for an hour or more. In sudden, severe attacks the patient springs from bed and rushes to an open window for air or else he will place himself in a chair and try to get into a position most comfortable for breathing. Most asthmatics have some special attitude which best enables them to use all the auxiliary muscles

of respiration and which they assume at the onset of the attack and keep until it begins to subside. The face becomes pale and anxious, the voice is gasping and speech is difficult, the eyes bulge and the face becomes cyanotic as the paroxysm continues; cold clammy perspiration covers the face, breathing becomes more difficult and laborious as the chest is now expanded and the expiration of air is very much prolonged. This breathing is accompanied by wheezing sounds upon the chest. The attack may last from one hour to several days; it subsides gradually, the patient begins to cough and rids his lungs of some frothy mucus in which is mixed grayish-white masses; he then feels greatly relieved, the color returns to his face, and he goes off into a sound sleep from which he awakens feeling greatly refreshed. A patient rarely, if ever, dies during a paroxysm as it is of spasmodic character, and once over it, he quickly regains his normal condition.

Children bear attacks better than adults, and in their case the disease is usually periodic in its recurrence, but as the years advance it tends to become more erratic both in its manifestations and time of appearance, and is apt to disappear at puberty. Persons past middle age are not apt to rid themselves of it, although they may live to a good old age and die of some other disease. Much can be done to prevent future attacks if the cause of the paroxysm can be determined and properly treated. Constipation, over-eating, and eating at bedtime should be avoided. An operation upon the nose may be necessary to remove a growth that is causing undue pressure upon the nasal septum. It is often advisable to move to another climate or locality. Endeavor should be made to strengthen the nervous system, if that be at fault; breathing exercises are often helpful. Another method, which has come into prominence of late, is to restore the stability of the respiratory centre by cauterizing the septal mucous membrane, and combining this with hygienic measures. This is performed by painting one side of the nasal septum with a few drops of cocaine and resorcin, and then drawing a line with a galvano-cautery point from a spot opposite the middle turbinated body, forward and slightly downward for a little less than half an inch. After an interval of six or seven days the operation is repeated on the other side. The heart, kidneys, gout and rheumatism should be treated separately and without reference to an asthmatic attack. During the attack a hypodermic injection of ¼ grain of morphia generally gives relief; amyl-nitrite inhaled or nitroglycerine 1/100 grain injected lessens the severity of an attack. Adrenalin by hypodermic injection is claimed by some to be very useful. Cigarettes of various kinds usually composed of a combination of the leaves of belladonna, stramonium and hyoscyamus are used and help some patients very much. Inhalation of fumes from burning blotting paper soaked in potassium nitrate (1/15) is also used. In the interval remedies recommended for internal use to prevent and lessen the severity of future attacks are potassium iodide, belladona, lobelia, hyoscyamus and grindelia robust.

ASTI, Italy, known in ancient times as Asta Pompeia, a city in the province of Alessandria. It is on the left bank of the Tanaro and on the railroad running from Alessandro to Turin, being about 35 miles southeast from the latter city. In outer aspect it presents much the same appearance that it did during the Middle Ages, with its narrow, twisting streets and ancient buildings. Among the latter is the cathedral, which was built in 1348. Early in its history it was noted for its beautiful pottery. In the Middle Ages it was one of the formidable city republics into which Italy was then divided. It is the centre of a fertile agricultural region; but the chief product of the neighboring districts is the sparkling wine named after the city and which alone causes it to be remembered in modern times. Pop. 41,252.

ASTIE, äs'tyā', **Jean Frédéric**, French theologian: b. Nérac, 21 Sept. 1822; d. 20 May 1894. He studied at Geneva, Halle and Berlin, then, in 1848, came to the United States, where he remained as a clergyman for five years. In 1856 he was appointed professer of philosophy and theology at Lausanne, Switzerland. In 1868 he became the editor of the *Revue de Théologie et de Philosophie*. He wrote 'Histoire de la république des Etats-Unis' (2 vols., 1865); 'Mélanges de théologie et de philosophie' (Lausanne 1878); 'Réalité, franchise et courage' (Paris 1888).

ASTIGMATISM, a defect of vision in which the rays of light do not converge to a single point on the retina. It is usually due to irregularities in the curvature of either the cornea or the crystalline lens, or of both, so that rays refracted in one meridian are brought to a focus at a point in advance of or behind those refracted in the meridian at right angles to the first, or it may be due to functional defective control of the crystalline lens. A slight degree of astigmatism is present in all eyes, because neither the cornea nor the anterior or posterior lens surface is part of a perfect sphere; but normally the defect is so slight as not to be noticeable. The conventional star-shaped appearance assumed by very distant points of light, as, for example, the stars themselves, is due to this universal defect. If, however, the radii of curvature are markedly unequal in the different meridians, a more or less serious blurring of the images formed on the retina by all objects results. Two main varieties of astigmatism are recognized. The commoner is *regular* astigmatism, in which there is a difference of curvature in two meridians, usually at right angles to each other, but the refraction is the same throughout any given meridian. In *irregular* astigmatism, however, there are variations of curvature along the length of the different meridians themselves; that is, each one does not, as in regular astigmatism, represent a segment of a circle. This form is usually the result of injury or disease of the cornea or lens, and is difficult to correct by glasses. Regular astigmatism is nearly always congenital and is frequently present in several members of the same family. The symptoms produced by astigmatism may be purely local and comprise blurred vision and fatigue after protracted near work, but even slight amounts may in some cases cause serious disturbances of the general health by the constant headache and reflex symptoms, such as

nausea and vomiting, dizziness, etc., that result. Many of these symptoms may be purely psychogenic and indicate an unwillingness on the part of the unconscious to overcome slight defects. The difficulties complained of are usually, at least partly, relieved by resting the eyes. Numerous methods of examination are employed by oculists to detect astigmatism, one of the simplest being the use of test diagrams representing radiating lines or sectors, rows of dots, etc., which, to the astigmatic eye, appear more or less blurred in certain meridians. The treatment consists in the use of glasses which are ground so as to compensate for the variations in refracting power of the optic media in the different meridians. This correction is accomplished by using cylindrical lenses, which are segments of cylinders and refract only at right angles to their axis, combined, if necessary, with the appropriate spherical lenses. Psychogenic symptoms may be relieved by a proper psychotherapy. See EYE; VISION, DEFECTS OF.

ASTLEY, Hugh John Dukinfield, English theologian and anthropologist: b. 29 Sept. 1856. In 1881 he was ordained a clergyman of the Church of England; in 1894 he was incumbent of the parish of Saint John the Evangelist, Brixton, after which he became vicar of East and West Rudham, Norfolk. In 1906 he was appointed Donellan lecturer at the University of Dublin. He was also librarian of the British Numismatic Society. Among his works are 'The Resurrection and Modern Thought' (1889); 'The Date of the Samaritan Pentateuch' (1892); 'The Housing Problems in the Country' (1901); 'The Higher Critics and Holy Writ' (1905); 'Portuguese Parallels to the Clydeside Discoveries' (1904); 'The Saxon Church at Bradford-on-Avon' (1905); 'Memorials of Old Norfolk' (1908); 'Prehistoric Archæology and the Old Testament' (1908).

ASTON, William George, Irish philologist: b. near Londonderry in 1841; d. Devonshire, 22 Nov. 1911. He became interpreter and translator to the British Legation at Tokio in 1870; assistant Japanese secretary at Tokio in 1875–80; consul-general for Korea in 1884–86; Japanese secretary at Tokio in 1886; and was retired in 1889. He published 'A Grammar of the Japanese Spoken Language'; 'A Grammar of the Japanese Written Language'; 'A Translation of the Nihongi; or, Annals of Ancient Japan'; 'History of Japanese Literature'; 'Shinto,' etc.

ASTON HALL, an old manor house in Birmingham, England, purchased by the city and turned into a museum. It is supposed to be the original "Bracebridge Hall" described by Washington Irving.

ASTOR, John Jacob, American merchant: b. Waldorf, Baden, near Heidelberg, 17 July 1763; d. 29 March 1848. He came to America in 1783, where his elder brother had settled and invested his savings in the fur trade. In 1784 he went with a cargo of furs to London; sold them and formed connection with fur houses there, and as his capital increased, made annual trips to Montreal, buying furs there and shipping them direct to London, as Canada was allowed to trade only with the mother country. In 1794 Jay's treaty removed this embargo, and Astor, then in London, at once made a contract with the Northwest Company of Montreal and Quebec (then the magnate of the Canadian Northwest fur trade), imported furs from Montreal to New York, and shipped them to all parts of Europe and China. The surrender of the lake posts under the treaty also greatly extended the trading limits, and Astor in a few years became one of the leading merchants and capitalists of the country, having a quarter of a million in 1798, and double that a few years later. In 1807 he embarked in direct trade with the Indians by way of the Mohawk, and with the English fur companies; but found the American trade chiefly monopolized by the Mackinaw Company, and knowing our government's desire to keep its home trade in home hands, proposed with its protection to accomplish this himself. In 1809 he secured a New York charter for the "American Fur Company," but the War of 1812 suspended operations, and after it a government prohibition of British fur trade in the United States broke up the company. Meantime a grander scheme had been initiated. Sir Alexander Mackenzie, after crossing the continent far north in 1793, had suggested establishing a line of trading posts from ocean to ocean, with terminal, coast and island stations, to draw all except the Russian fur trade into one channel. Lewis and Clarke's transcontinental expedition in 1804 proved its practicability on American soil, and Mr. Astor evolved the plan of distributing such posts along the Missouri and Columbia rivers, with a central station at the mouth of the latter, where all the peltries from the interior and those gathered by coasting vessels were to be collected and taken by a yearly ship to Canton, loading in return with Chinese goods. A later development was to operate a line of ships from the Pacific coast to the Chinese and East Indian ports, with a Hawaiian island for an intermediate port. The Russian Fur Company had already complained to the United States of the casual American trading vessels selling liquor and firearms to their Indians; the American government had consulted Astor for a remedy and his idea was to abolish this irresponsible trading by making his yearly supply ship take its place. To prevent ruinous competition he offered the Northwest Company a one-third interest in the enterprise; but they declined it and sent a company to seize the mouth of the Columbia before his party could arrive. He succeeded in spite of them, however, in planting a settlement, which was named Astoria; but on the breaking out of the War of 1812 the English seized it. It reverted to the United States by the Treaty of Ghent, and Astor wished to revive the project, but the government was cool, and he dropped it, still however, buying his furs direct and trading with many countries, more particularly China, at that time the best fur mart in the world. He also made large amounts by buying depreciated government securities, which afterward commanded a considerable premium. But his chief investment was the one which has founded the family greatness on a rock. Foreseeing the immense growth of New York city, he bought large tracts on Manhattan Island far beyond the then city limits, taught his son to invest his accumulations in the same way, and established the system of handling them described under ASTOR FAMILY. In 1827 he and

his son William, who had been his partner since 1815, withdrew from the China trade and formed the American Fur Company, chiefly managed by the great expert; but a few years later he retired from business altogether, thenceforth devoting himself to his investments, and devising, in consultation with others, plans for a public library suggested by Washington Irving,—afterward the Astor Library, for which he left $400,000 in his will. He made gifts and bequests to other objects; among them $50,000 for a school for poor children and a home for the indigent aged in his birthplace, Waldorf, called the Astor House. He was much more than a great trader: he had a breadth of conception, a combined energy and patience of execution, a mastery of detail, a retentiveness of memory and a sagacity of judgment, which in the opinion of his intimates would have raised him to greatness in any line. He left two sons, William B. and John Jacob, and three daughters.

ASTOR, John Jacob, American capitalist and soldiér, son of William B.; b. New York, 10 June 1822; d. 22 Feb. 1890. He was educated at Columbia University and at Göttingen; he then took the full course at the Harvard Law School, and practised law for a year, solely to qualify himself for assisting in the management of the immense estate, one-half of which later descended to him. In the Civil War he served on McClellan's staff, with the rank of colonel; and was a devoted and hard-working military student. He always regarded this period as the best of his life, and attended the reunions of the Loyal Legion with zeal. Not only was he always a liberal giver to public institutions and charities, but he gave much personal time and devotion to them, especially to the Astor Library and Trinity Church; but he shrank from public notice. On his father's death in 1875 he received half of the estate, estimated at considerably over $100,000,000; all which, with accumulations believed to have swollen it to some $200,000,000, he left to his only son, William Waldorf Astor. His wife, Charlotte Augusta Gibbs, was an active assistant in his charitable work, taking part in personal service as "Sister Augusta," incognito.

ASTOR, John Jacob, American capitalist and inventor, fourth of the name, nephew of John Jacob the third, and son of William: b. Rhinebeck, N. Y., 13 July 1864; d. at sea (Titanic wreck) 15 April 1912. He was graduated from Harvard in 1888. He was the manager of the Astor properties in America; a director in many banking, insurance and railroad companies, and member of various clubs and social organizations. He built in 1897 a very costly hotel, the Astoria (named after the famous fur settlement of 1811), on Fifth avenue, New York, adjoining the Waldorf built by his cousin, William Waldorf, the two being now joined as the Waldorf-Astoria. Besides his business activities, he had strong individual faculties. He was an expert in marine mechanics, inventor of a bicycle brake, and a pneumatic road improver; and was a member of scientific and other intellectual societies. He wrote 'A Journey in Other Worlds: a Romance of the Future' (1894). He was on Governor Morton's staff 1894–96, and in the Spanish-American War of 1898 was commissioned lieutenant-colonel of United States Volunteers, and served in the Santiago campaign.

ASTOR, William Backhouse, American merchant and capitalist, eldest son of John Jacob Astor: b. New York, 19 Sept. 1792; d. 24 Nov. 1875. He was trained in his father's business in the intervals of public school education; and the father is said to have remarked that "William would never *make* money, but would keep what he had." At 16 he was sent to Heidelberg University, and at 18 went to Göttingen, where he was tutored by Bunsen, afterward the great chevalier. Returning to New York in 1815, he was made a partner in his father's foreign shipping trade, especially cultivating the Chinese field. The firm was John Jacob Astor & Son till 1827, when it dissolved and both partners gave up the China trade to form the American Fur Company, of which William was president, but John Jacob the head manager till he withdrew from active business life a few years later. He was shortly followed into retirement by his son. By 1848 he had amassed a fortune of his own; besides receiving a legacy of half a million from his uncle Henry, and a gift of the Astor House from his father; the latter on his death in that year leaving him sole legatee save for minor bequests, the property being estimated at $20,000,000 to $30,000,000. His life thenceforth was spent in conserving and developing this. He built nearly a thousand houses on his uptown lots, and was currently termed "the landlord of New York." He was also a heavy investor in other lines, notably coal and railroad stocks. He founded the Astor Library under his father's bequest, adding by gifts and bequests over $600,000 to his father's gift, giving much time to its administration from the completion of the building in 1853 on his plans. His wife was the daughter of Madison's second Secretary of War; his sons were John Jacob and William, and the estate was shared between them.

ASTOR, William Waldorf, capitalist: b. New York, 31 March 1848. He was called to the United States Bar in 1875; was a member of the legislature of the State of New York 1878–81; and was United States Minister to Italy 1882–85. In 1890 he transferred his residence to England and in 1899 became a naturalized British subject. In 1892 he purchased the *Pall Mall Gazette;* in 1893 he established the *Pall Mall Magazine,* and in 1911 acquired *The Observer.* In 1912 he sold the first named journal, and in 1914 made a present of the *Pall Mall Gazette* and *The Observer,* with the building in Newton street and its contents, to his son, Maj. Waldorf Astor, M.P. He is the author of 'Valentino,' a story of Rome (1886); 'Sforza,' an historical romance of the 16th century in Italy (1889); 'Pharaoh's Daughter, and Other Stories' (1889), besides numerous stories and articles that have appeared in the pages of the *Pall Mall Magazine.* His benevolence is well known and his gifts to charities have amounted to very considerable sums. Among those charities benefited by his gifts are The Hospital for Sick Children, Great Ormond street (to which he gave $250,000 in 1903); University College, London; The Cancer Research Fund; Oxford University; Cambridge University; The National Society for the Prevention of Cruelty to Children; The British

Red Cross Society; Gordon Memorial College, Khartum; The Soldier and Sailors' Families Association, and the Women's Memorial to Queen Victoria. His gifts to the war charities include $125,000 to the Prince of Wales's National Relief Fund; a similar amount to Princess Louise's Officers' Families Fund; $200,000 to the British Red Cross Society; $25,000 to Queen Mary's Employment Committee, and a similar sum to the Lord Mayor's National Bands Fund. He has given $5,000 to King Edward's Hospital Fund annually since 1897 when the fund was started. On 1 Jan. 1916, he was offered and accepted a peerage of the United Kingdom under the title of Baron Astor of Hever Castle in the County of Kent. Hever Castle is well known as having been the residence of Anne Boleyn and the place at which her courtship by Henry VIII was carried on. It was purchased with the surrounding estate by Mr. Astor in 1903. On 3 June 1917 Baron Astor was elevated to the rank of Viscount.

ASTOR FAMILY, a famous American family representing one of the three or four greatest private properties in the world. A family in the Old World sense,—a territorial aristocracy, impossible to destroy, and fortified with legal immunities and privileges,—can hardly be founded in America; but the Astors have approached it as nearly as our institutions will admit. They form a group of immense hereditary real-estate owners, with holdings so solidly based and well distributed in the metropolis of America that no apparent catastrophe save a failure of heirs could extinguish it; and though originally springing from mercantile business, removed by some three-quarters of a century from its actual conduct. For many years they were known as "the landlords of New York," and the best of landlords, prompt, just and courteous; they still probably form the largest set of individual real-estate holders. The family is also connected with notable municipal charities and public foundations. See ASTOR, JOHN JACOB (1763–1848); ASTOR, JOHN JACOB (1822–90); ASTOR, JOHN JACOB (1864–1912); ASTOR, WILLIAM BACKHOUSE (1792–1875); ASTOR, WILLIAM WALDORF (1848–).

ASTOR LIBRARY. See NEW YORK PUBLIC LIBRARY.

ASTOR PLACE RIOT, in American history: a riot on the evening of 10 May 1849, in Astor Place, New York. It was an attempt to drive the English actor, William Charles Macready (q.v.) from the stage, and grew out of a London tour of Edwin Forrest (q.v.), in which he played Virginius and Richelieu with great success till Macready bought the acting rights for himself, though he had personally treated Forrest with kindness. Forrest then essayed Macbeth, but it was unsuited to his style and presence, and he was hissed. He attributed this to Macready's machinations, and when Macready four years later announced 'Macbeth' in the Astor Place Opera House, a crowd of Forrest's partisans gathered early in the evening before the theatre, and waiting till the performance had begun, attempted to force a way inside and put a stop to it. The police were powerless and sent for the military; the Seventh Regiment (New York militia) came up, and was assailed by the mob with showers of brickbats and stones. Before the fray was ended, 34 rioters were killed, a great number wounded and 141 of the regiment injured by the missiles. The mob was successful in its purpose, however. Macready had to cancel his engagement, conceal himself in a private house for a couple of days, and then travel secretly to Boston, whence he sailed for England. Consult Barrett, 'Edwin Forrest' (1882).

ASTORGA, Emanuele d', an Italian composer: b. Palermo, 11 Dec. 1681; d. 21 Aug. 1736. He was educated in a monastery in Astorga in Spain, from which he afterward took his name. A 'Stabat Mater,' which he is said to have written in London, is considered the best of his works, and is still highly regarded.

ASTORGA, ȧs-tōr'gȧ, a city in northwest Spain, province of Leon, the *Asturica Augusta* of the Romans. It figured prominently during the Peninsular War; was taken by the French after an obstinate defense, 1810; and retaken by the Spaniards, 1812. It is the see of a bishop. Pop. 7,600.

ASTORIA, Ore., city, port of entry and seat of Clatsop County, on the Columbia River, nine miles from its mouth, and 101 miles by the Astoria & C. R. Railroad from Portland. Several foreign steamship lines touch here, the largest vessels coming up to its five miles of water frontage through the deep, broad channel dredged in the bar at the river mouth. Its salmon fishing and canning industries are among the greatest in the world: several hundred boats go out to the fishing grounds on the bar every afternoon during the season of about 100 days, some 1,500 in all being employed; and the canneries utilize some $2,000,000 capital, and turn out about 15,000,000 cans of salmon a year. It has also subsidiary can manufactories and iron works, great lumber works from the vast forests of the Pacific slope, flouring mills, breweries, etc. The United States census of 1914 recorded 57 manufacturing establishments of factory grade, employing 1,375 persons, of whom 1,172 were wage earners, receiving $866,000 annually in wages. The capital invested aggregated $5,293,000, and the year's production was valued at $4,587,000: of this, $1,836,000 was the value added by manufacture. The city has a very large export trade in the special products of Oregon and Washington—lumber, wheat, oats, live stock, wool, potatoes, apples, etc. Among its buildings, the most notable are the United States custom-house, the post office, Saint Mary's Hospital (R. C.), and Fort Clatsop dating from its foundation by the Lewis and Clarke expedition in 1805. For the founding of Astoria in 1811, see ASTOR, JOHN JACOB, and consult Irving, W., 'Astoria, or Anecdotes of an Enterprise beyond the Rocky Mountains' (Philadelphia 1836). On its seizure by the English in the War of 1812, they renamed it Fort Saint George; in 1818 it was restored to the United States, though occupied till 1845 by the fur stations first of the Northwest Company, then of the Hudson Bay Company with which the former consolidated. It received a city charter in 1876. Pop. (1910) 9,599; (1914) 10,100.

ASTORIA, or ANECDOTES OF AN ENTERPRISE BEYOND THE ROCKY MOUNTAINS, a rambling work by Washington Irving (1836). It comprises stories of expeditions by land and

sea, and as a chapter of Far West history, does not lose its value by the lapse of time.

ASTRABAD, äs'trą-băd', Persia, a town about 30 miles east of the Caspian Sea. It carries on a trade in horses, sheep, cotton, silk, woolen fabrics, etc., and is connected by caravan with Afghanistan and is the seat of a Russian consulate. Pop. estimated at about 15,000 to 20,000.

ASTRÆ, The Divine, a name applied to the English novelist and dramatist, Mrs. Aphra Behn, a Jewess, who was noted for the coarseness of her plays. "The stage how loosely doth Astræa tread." She was the first English female novelist.

ASTRÆA, in mythology, the daughter of Zeus and Themis, and goddess of justice. In the age of gold she was a regular inhabitant of this world; in the age of silver an occasional visitor; and in the age of brass, when men began to forge weapons of war, fled to the skies, where she is seen in the Zodiac, forming the constellation Virgo. She is usually represented with scales in her hand and a crown of stars on her head.

ASTRAGAL, in architecture, a small semi-circular molding, with a fillet beneath it, encircling a column and separating the shaft from the capital.

AS'TRAGALOMAN'CY (Greek *astragalos,* in the plural = dice, and *manteia* = divination), a pretended divination performed by casting down dice with marks corresponding to letters of the alphabet, and observing words thus formed. It was practised in the temple of Hercules, in Achaia.

ASTRAGALUS. See Foot.

ASTRAGALUS, Milk Vetch, a genus of more than 1,000 species of hardy leguminous herbs and under-shrubs which, except in Australia where they have not been found, are of world-wide distribution on dry soils. *A. gummifer* and other species yield tragacanth (q.v.) gum. Certain species native to the western United States called crazy weeds (q.v.) are considered responsible for crazy disease of stock. The leaves are usually pinnate; the flowers arranged in racemes, white or purple. A few native and foreign species are grown from seed for ornamental purposes. They succeed best on dry, porous soil in sunny situations.

ASTRAKHAN, a name given to sheepskins with a curled woolly surface obtained from a variety of sheep found in Bokhara, Persia and Syria, and also to a rough fabric with a pile in imitation of this.

ASTRAKHAN, äs'trą khän', a government in the southeast of European Russia, on the Caspian; with an area of about 91,042 square miles. It consists almost entirely of two vast steppes separated from each other by the Volga, and forming for the most part arid sterile deserts. The livestock consist chiefly of sheep of the broad-tailed species. The chief employments are pasturage and fishing — the former occupying the rural and nomadic tribes, and the latter the tribes on the Caspian coast and the banks of the Volga. The extraction of salt from the lakes is also a source of employment. The population is extremely diverse — consisting of Kirghiz, Kalmucks, Tatars, Cossacks, Armenians and Jews — and numbered in 1914 1,315,900.

ASTRAKHAN, the capital of the Russian government of the same name. It is situated on an island in the Volga, about 60 miles from the Caspian Sea, is surrounded by a wall and consists of crooked, dirty, but broad streets, with irregular lines of houses. The communication with the opposite banks of the river is maintained by numerous bridges. It is the see of Greek Catholic and Armenian archbishops, and there are numerous sacred edifices, including mosques and an Indian temple. The most important edifice is the cathedral, of a rectangular form, with four small gilt and painted cupolas on the roof, and a large one in the centre. The city gives its name to a kind of fur, the skin of new-born Persian lamb, and its imitation in rough woolen coats. The manufactures, consisting of silks, cottons, woolens, shagreen skins, morocco leather and soap, are increasing in extent. The fisheries, shipbuilding and tanning are the staple industries. Immense quantities of fish, caviar, and isinglass are exported to foreign countries. In the fishing season from 20,000 to 30,000 persons connected with the fisheries frequent the city. It is the naval station of the Caspian fleet; is the most important port of the Caspian, and has regular steam communication with the principal towns on the shores of that sea. The development of the petroleum fields at Baku and the opening of the Trans-Caspian Railway have increased its importance as a centre of trade between western Europe and central Asia. The city fell into the hands of Russia in 1554. Pop. (1913) 162,482.

ASTRAL BODY, a term used by Theosophists. According to their belief the soul has two bodies, one of attenuated matter which is sometimes able to carry the spirit away from the material body during sleep, and which may survive the death of the material body for some time. See Theosophy.

ASTRAL SPIRITS, spirits believed by the Greeks and Orientals to inhabit the heavenly bodies or the aerial regions. In the Middle Ages they were variously conceived as fallen angels, souls of departed men or spirits originating in fire, and belonging neither to heaven, earth nor hell. Paracelsus regarded them as demoniacal in character.

ASTRAPOTHERIIDÆ, a family of hoofed mammals, fossil in the Santa Cruz beds of Miocene Age in Patagonia, which had a rude resemblance to the primitive rhinoceroses. Their most remarkable feature was a long, trunk-like proboscis.

ASTRINGENTS. Substances that have the property of precipitating albumin and other proteids act as astringents. When used on mucous membranes they contract the tissues, diminish the blood supply, decrease the mucus and modify the sense perceptions in the part. In the mouth they cause the well-known sensation of puckering. Their action is purely local. Vegetable astringents all contain tannic acid, to which substance their action is due. Nearly all of the mineral salts are astringent when used well diluted with water. In concentrated solution their coagulant action is so

pronounced as to cause death of the tissue (caustic). The astringents are particularly serviceable in stimulating atomic mucous membranes, causing them to secrete less mucus. They are thus useful in chronic diarrhœas, in leucorrhœa and in mucous discharges from other parts of the body. The most serviceable of the vegetable astringents is tannic acid, or its compounds, tannalbin, tannigen and related bodies. Others used are rhatany, catechu, kino, logwood and white-oak bark. Of the mineral salts, solutions of copper sulphate, zinc sulphate, lead acetate, nitrate of silver, sulphate and chloride of iron, alum, sulphuric, hydrochloric, nitric acid, and the aluminum salts are the most useful.

ASTROCARYUM, a genus of about 30 species of tropical American pinnate-leaved palms noted for their profuse sharp spines sometimes a foot long. *A. murumuru,* the murumuru palm, a common species in the lower Amazon region, seldom attains a height of more than 20 feet. It bears an edible, melon-flavored, musky-scented ovoid fruit about an inch long, the pulp of which is highly prized as food for man and cattle. Hogs crush the seeds, which are almost as hard as vegetable ivory, and fatten well upon them. *A. tucuma,* the tucuma palm, reaches a height of 30 to 40 feet, and has very regularly arranged spines, bears an edible, globular fruit, and is native of the same region as the preceding species. *A. vulgare* is a taller-growing palm than the above. The unexpanded leaves furnish a strong fibre, for which the tree is often cultivated where it is not native. To obtain this fibre the terminal bud is cut and the epidermis of the delicate leaves carefully peeled in ribbon-like strips that when dry are twisted into fine, strong, durable threads used for making twine, bowstrings, hammocks, fish-nets, etc. The fibre of older leaves is coarser, tougher and stronger and is used for cordage; the petioles of the young leaves are used for making into baskets and hats. This species, commonly known as the tecum palm, is distinct from the tucuma palm noted above, but was confounded with it by Martius, who pictured the tucuma as the fibre-bearing species. Consult Wallace, 'Palm Trees of the Amazon' (1853). Several species are cultivated in greenhouses for ornamental purposes and specimens as large as 10 feet tall often bear fruit. For culture, consult Bailey, 'Standard Cyclopedia of Horticulture' (1914).

ASTROLABE (from Greek *astron,* a star, and *lambano,* I take), the name given by the Greeks to any circular instrument having one or more graduated circles. In modern astronomy this instrument is no longer used, because wholly superseded by the sextant. The first application of the astrolabe to navigation was made by the physicians, Roderich and Joseph and Martin Behaim of Nürnberg, when John II, King of Portugal, desired them to invent a method of preserving a certain course at sea. Angles of altitude were found by suspending the astrolabe perpendicularly.

ASTROLOGY, the science which claims to foretell future events, especially the fate of men, from the position of the stars. Originally, that is, among the Greeks and Romans, the word had the meaning of "astronomy," and, as in the case of alchemy and chemistry, the pseudo-science and the real science had the same origin. In early times, when the earth was regarded as the centre of the universe and as that to which all else was somehow tributary, it was a not unnatural hypothesis that the changing configurations of the heavenly bodies might be indicative of human destiny, or might influence human character. Hence, the Chinese, the Egyptians, the Chaldæans, the Romans and most other ancient nations, with the exception of the Greeks, became implicit believers in astrology. It was partly the cause and partly the effect of the prevalent worship of the heavenly bodies. The "star-gazers," sarcastically referred to in Isa. xlvii, 13, were perhaps astrologers; so also may have been what are called in the margin "viewers of the heavens"; but the Hebrew word rendered "astrologers" in Dan. i, 20; ii, 2, 27; iv, 7; v, 7, is a much vaguer one, meaning those who practise incantations, without indicating what the character of these incantations may be. The later Jews, the Arabs, with other Mohammedan races, and the Christians in mediæval Europe were all great cultivators of astrology. Some of the greatest astronomers, among whom was John Kepler, who knew very much better, were accustomed to "cast horoscopes," and to receive large fees for so doing. The ordinary method of procedure in the Middle Ages was to divide a globe or a planisphere into 12 portions by circles running from pole to pole, like those which now mark meridians of longitude. Each of the 12 spaces or intervals between these circles was called a "house" of heaven. The sun, the moon and the stars all pass once in 24 hours through the portion of heavens represented by the 12 "houses." Every house has one of the heavenly bodies ruling over it as its lord.

The houses symbolize different advantages or disadvantages. The first is the house of life; the second, of riches; the third, of brethren; the fourth, of parents; the fifth, of children; the sixth, of health; the seventh, of marriage; the eighth, of death; the ninth, of religion; the tenth, of dignities; the eleventh, of friends; and the twelfth, of enemies. The houses vary in strength, the first one, that containing the part of the heavens about to rise, being the most powerful of all; it is called the ascendant, while the point of the ecliptic just rising is termed the horoscope. The important matter was to ascertain what house and star was in the ascendant at the moment of a person's birth, from which it was deemed possible to augur his fortune. It followed that all people born in the same part of the world at the same time ought to have had the same future, an allegation which experience decisively contradicted. Even apart from this, astrological predictions of all kinds had a fatal tendency to pass away without being fulfilled; and when, finally, it was discovered that the earth was not the centre of the universe, but only a planet revolving around another body, and itself much exceeded in size by several of its compeers, every scientific mind in Europe felt itself unable any longer to believe in astrology, which has been in an increasingly languishing state since the middle of the 17th century. It still flourishes, however, in Asia and Africa, and is a means of livelihood to

many charlatans who prey upon the ignorant classes in all countries.

ASTRONOMICAL CLOCKS. See ASTRONOMY, PRACTICAL.

ASTRONOMY. Astronomy is that branch of science which treats of the heavenly bodies — including practically all the bodies of the universe. The great advance which our times have witnessed in the methods of research has made it one of the most progressive of the sciences, while it is, at the same time, the oldest of all. The vast extent of its field, including the entire universe within its bounds, leads to its having a number of different branches. There is, first, a branch which embraces our general knowledge of the heavenly bodies, their motions, aspects and physical constitution. This branch is commonly termed *descriptive* or *general astronomy*. It is now recognized as having two divisions, one relating principally to the motion, mutual relations and general aspects of the heavenly bodies; the other to their physical constitution, considered individually. The former division is sometimes termed *astrometry*, because it is principally concerned with measurements of position, motion, mass, etc. The other branch is termed *astrophysics*, and is that which has received its greatest development in recent times. There is also a branch which teaches the methods of observing the heavenly bodies, including the instruments used in observation and measurement, and the principles governing their use, as well as the practical computations incident thereto. This branch is termed *practical astronomy*. Another branch is the mathematical one, which determines the orbits and motions of the heavenly bodies by deductive methods, taking as a basis the facts of observation and the laws of motion, especially that of gravitation. This branch treats of the orbits of the heavenly bodies and of the methods of computing the effects of their mutual attraction. It is commonly termed *theoretical astronomy*, while the more purely mathematical theory is known as *celestial mechanics*.

The subject of astronomy is treated in the present work on the following plan: We begin with a brief but comprehensive survey of the universe, referring to special articles — Stars, Universe, Nebulæ, Solar System, etc., for details. This survey will be followed by reviews of Practical Astronomy, Theoretical Astronomy and of the historical development of the science.

Descriptive Astronomy. — Considered as to their nature, the heavenly bodies may be divided into two great classes; the one, incandescent bodies which shine by their own light; the other, opaque bodies which are visible only by reflecting the light of some incandescent body in their neighborhood. Examples of the first class are the stars which stud the heavens at night; examples of the second are the planets, of which our earth is one. From the very nature of the case, little can be learned of the possible number of opaque bodies which may exist in the universe. There may be some rather uncertain ground for inferring that they are less massive and less numerous than the incandescent bodies; but it is sometimes supposed that they may far outnumber the latter without our being aware of the fact. The stars are scattered through the wilderness of space at distances which baffle all our powers of conception. Light moves with such speed that it would make the circuit of the earth seven times in a single second. But the cases are rather exceptional when a star is so near one of its neighbors that light would not take years to travel over the distance which separates them. Indeed, the only known exceptions belong to the class of double or multiple stars — two or more such bodies forming a system by themselves. There is only one star so near us that its light would reach us in four years, and the same is probably true of most other stars. That the universe of stars extends to distances which light would require several thousand years to travel is certain; but no well-defined limit has yet been set to its extent. Our sun is one of the stars, and is the one of which we know most because of our proximity to it. It is the centre around which eight great planets and a number of other bodies perform their revolutions. On one of these great planets, the third in the order of distance, we dwell. Our knowledge of the heavens is largely conditioned by our residence on this planet. We see the other planets by the light of the sun, which they reflect. They present to the naked eye the appearance of stars; and it is only when scrutinized with the telescope that they are found to have a measurable apparent size. Vast indeed is their distance from the sun when measured by our standards. Yet, the dimensions of our solar system are very small when compared with the distance which separates the stars. Light passes from the sun to the outer planet, Neptune, in about four hours, while, as we have said, it requires years to reach any star. The nearest star is therefore thousands of times farther than the most distant planet. A most interesting question is whether other stars have systems of planets revolving round them, as our sun has. This is a question which it is impossible to answer conclusively. Such planets would be absolutely invisible through the most powerful telescope that man can ever hope to construct. Yet certain theoretical considerations seem to render it probable that many, and perhaps the majority, of the stars have planets revolving around them. It is generally held by astronomers that all stars were originally nebulæ; investigation shows that if the nebula was of a more or less heterogeneous structure it will develop, at least usually, into a central sun attended by a system of planets (see COSMOGONY). As by far the greater part of the nebulæ of the sky are of a spiral structure, and hence far from having a uniform density, it is indicated that this is the usual condition of these objects; it is thus rendered probable that at least many of the stars are the centres of systems which more or less closely resemble our own. In special cases evidence on the subject is afforded by the spectroscope, which shows that great numbers of stars really have one or more dark bodies revolving around them. But, in order to be observable with the spectroscope, these bodies must be vastly larger than the planets which revolve round our sun. The existence of a planet like that on which we dwell could not be determined even with the best spectroscope.

The bodies of the solar system are bound together by the law of gravitation. Were it

not for the attraction of the sun each planet would fly off in a straight line through space. Through the attraction of the sun all the planets are kept in their several orbits. Every consideration leads us to believe that gravitation extends from one star to all the others, but diminishing as the inverse square of the distance. Revolving double stars show that systems of two stars in proximity to each other are subject to the law of mutual attraction and hence that gravitation is not peculiar to our solar system, but operates throughout the entire visible universe.

All of the stars are in motion, some of them with exceedingly high velocities, but though there are several instances of streams of stars, the members of which are moving along parallel paths with the same velocities, in nearly all cases the stars are found to be moving indifferently in any direction and with different velocities. Though we do not doubt that their motion is fully determined by the combined pull upon them of all of the bodies which compose our universe, the nature of the resulting motion in any particular case is necessarily very complicated. Attempts have been made from a study of the actual motions observed to estimate the total mass of our universe and so to form an estimate of the mass of the dark suns and other opaque matter which is invisible to us. But the result is naturally subject to very great uncertainty. It will require the observations of many centuries, and perhaps of many millenniums, before the total mass of matter in our universe and its distribution can be determined in this way.

The three fundamental facts which determine the great phenomena of astronomy, as we observe them in the course of our lives, are (1) the globular form of the earth on which we dwell; (2) its diurnal rotation on its axis; (3) its annual revolution round the sun. The first of these facts is so familiar to all that we need not discuss it. Out of it grow the general phenomena of the sky. The heavenly bodies surround us in every direction. They are really as numerous by day as by night, only in the former case they are blotted out by the brightness of the sky. To imagine the heavens as they really are we must fancy stars as always visible in every part of the sky. Then, by day, we should see the sun among the stars, and perhaps the moon also. Mere observation of a heavenly body gives us no idea of its distance. By looking at a star we cannot tell whether its distance is to be measured by hundreds of miles, by millions or by thousands of millions, which it actually is. Hence, all the heavenly bodies appear to us to be at the same distance, as if they were set upon the interior surface of a stupendous sphere in the centre of which we seem to be placed. This imaginary form is called the celestial sphere; it is one of the most ancient conceptions of astronomy, and it is used in the science to the present day to represent the appearance of the heavens. It is divided into two hemispheres, a visible and an invisible one. The visible hemisphere is the half which is above the horizon, which we call the sky and can always see, except so far as obstructions or inequalities of the ground may prevent. The other half is below the horizon, and is hidden from our view because the earth is opaque. Were the latter transparent, we should see the heavenly bodies in every possible direction. The rotation of the earth on its axis produces the phenomena of day and night, and the apparent rising and setting of the heavenly bodies. This is known as the diurnal motion. The latter may be considered in two aspects, either as the real rotation of the earth on its axis, in a direction always toward the east, or as an apparent rotation of the heavens in the opposite direction, due to our being unconscious of the motion of the earth. In consequence of the diurnal motion the celestial sphere, seeming to our eyes to carry the heavenly bodies on its interior surface, appears to us to make a daily rotation on its axis. The two opposite points of the celestial sphere situated on the prolongation of the earth's axis are called the celestial poles. On these poles as pivots the celestial sphere seems to turn. They are called north or south according to the direction. Their apparent position in the sky depends on the latitude of the place where the observer is situated. A heavenly body situated at either pole does not seem to have any diurnal motion. This is nearly the case with the pole star, which dwellers north of the equator can always see at an altitude above the northern horizon equal to their latitude. A voyager into the southern hemisphere sees the pole star set when he crosses the equator. Then, the south polar star would be visible if there were one. But it happens there is no bright star very near the southern prolongation of the axis. In the United States, say from 30° to 45° of latitude, the pole star is at a corresponding altitude above the horizon, and all the stars in its neighborhood appear to make a diurnal rotation round it, without changing their form or position, and without ever setting. Any one who chooses can verify this fact by noting the appearance of the northern sky about the end of twilight, and then looking at it again two or three hours later. He will then see that stars below the pole have moved toward the east; those on the east side of it have risen higher, and those on the west side are lower, while those above have moved over toward the west. For us, therefore, the sphere of the heavens may be divided into three parts; a circle round the north celestial pole within which stars never set; a corresponding circle round the south pole, the stars in which never rise above our horizon, and a broad middle region where they rise and set.

To represent the positions of the stars, astronomers imagine circles on the celestial sphere corresponding to the circles of longitude and latitude on the earth. As we imagine north and south meridians drawn on the earth from one pole to another, to measure terrestrial longitudes, so we imagine in the heavens circles drawn on the sphere from the north celestial pole to the south one. As the longitude of a place on the earth is expressed by the angle which its meridian makes with the meridian of Greenwich, so the corresponding quantity for a star is the angle which the circle through it makes with a certain prime meridian on the celestial sphere. This quantity for the stars is not called longitude, but *right ascension*, and the celestial meridians which determine it are called *hour circles*.

Rotunda Panel in the State Education Building, Albany, N. Y. Mural Painting. Copyright by Will H. Low

ASTRONOMY AND GEOGRAPHY

Minerva, goddess of wisdom, encircles with her arm a young child, while through the telescope she directs his gaze to the " clear night of stars " spread above him; at sight of which the child clasps his hands with a gesture of wonder. Near at hand a seated youth, holding the symbolic lamp of research, is bent over a large globe following the path of man over the traveled earth. Above and behind the terrace on which these figures are seated rises the façade of the library of Columbia University, New York

In the same way as we have on the earth a great circle spanning it, everywhere equally distant from the two poles, and called the equator, so we imagine a circle spanning the heavens, everywhere equally distant from the north and south celestial poles, which is called the celestial equator, or the equinoctial. At any one place this circle will be apparently fixed in its position, always intersecting the horizon at its east and west points, and, in our latitudes, intersecting the meridian south of the zenith by a distance equal to our distance from the equator. For example, to a dweller in latitude 40°, the highest point of the celestial equator will be 40° from the zenith, and 50° above the horizon. From this point it spreads toward the east and west until it intersects the horizon as just stated. As a traveler journeys south, the position of the celestial equator becomes more and more nearly vertical; at the equator it rises vertically and passes through the zenith; south of the equator it passes north of the zenith.

As the latitude of a place is measured by its angular distance from the equator north or south, so the corresponding number for a star is measured by its mean angular distance from the celestial equator, whether north or south. This is called the star's *declination*. Thus the right ascension and declination of a star determine its position on the celestial sphere just as longitude and latitude determine the position of a city on the earth. All star charts are constructed with this system of circles as a basis; in all modern star catalogues it is the right ascension and declination that are tabulated.

We now have to consider the effect of the annual motion of the earth round the sun. If we watch the heavens at a certain hour every evening, say eight o'clock P.M., we shall find that the stars are every night a little farther advanced in their diurnal motion then they were the night before. If they are in a certain position at eight o'clock on one evening, they will pass the same position four minutes before eight on the next night, eight minutes before eight on the next night, and so on. In the course of a year these continually accumulating changes make up the whole 24 hours, so that a star which is in the zenith this evening will be on the meridian at eight o'clock in the morning six months hence, while at eight in the evening it will be at its greatest distance below the horizon. If we could see the sun among the stars, what we should notice would be that our luminary always forges a little farther east day after day, and in the course of a year seems to make a complete revolution among the stars. The result is that while the sun rises and sets 365 times, the stars rise and set 366 times. Since the latter are always in the same absolute direction, and seem to rise and set in consequence of the earth's rotation on its axis, we infer that the direction of the sun from the earth goes through a complete revolution in the course of a year. In other words, the sun appears to us to make an annual revolution around the celestial sphere among the stars. Since the time of Copernicus it has been known that this appearance is due to the actual revolution of the earth around the sun.

The apparent path of the sun among the stars can be mapped out by astronomical observation. When carefully observed, it is found to be a great circle of the sphere, called the ecliptic. We thus have two imaginary circles of fundamental importance spanning the heavens. One is the celestial equator, the other the ecliptic in which the sun seems to travel. These circles do not coincide, but intersect each other at two opposite points at an angle of 23½°. This is called the *obliquity of the ecliptic*. The result of it is that during one-half the year the sun is south of the celestial equator, and during the other half is north of it. In the northern half of its course we have summer in the northern hemisphere and winter in the southern; in the southern half we have summer in the southern hemisphere and winter in the northern. Thus the changing seasons are due to the obliquity of the ecliptic. If the latter coincided with the equator, we should have no such annual round of seasons as that with which we are familiar.

There are two opposite points on the celestial sphere at which the equator and the ecliptic intersect. These are called *equinoxes* because, when the sun crosses them, the days and nights are equal all over the earth. That equinox which the sun passes toward the north is called the vernal equinox, because the crossing marks spring in the northern hemisphere. The other is called the autumnal equinox for a similar reason. Observations continued through many centuries show that the equinoxes are not fixed, but travel slowly along the ecliptic at such a rate that they make a complete revolution from the east toward the west in about 26,000 years. This motion is called the precession of the equinoxes. Its existence shows that the direction of the earth's axis is slowly changing, and hence the position of the celestial pole is changing also. Since the equator is defined by the condition that it spans the heavens midway between the celestial poles, this change in the poles causes a corresponding change in the equator.

The actual motion of the pole is at the rate of about 20″ per year. The smallest visible object that can be seen with the naked eye to be anything else than a point of light subtends an angle of about 1′ or 60″. It follows that the pole moves through this smallest visible space in three years. In a long life of 90 years the change would be about equal to the diameter of the sun or moon. The centre of the motion is the pole of the ecliptic which is distant from that of the equator by about 23½°. Owing to the smallness of the obliquity, the equinox travels along the ecliptic at more than twice the rate of the pole, or about 50″ per year. It has therefore changed about 30° since its motion was first noticed, about 2,000 years ago. It is found that the planets describe their course around the sphere in circles which do not deviate greatly from the ecliptic. A belt of the heavens extending 8° on each side of the ecliptic will include all the planets visible to the naked eye. This belt is called the zodiac. Beginning at the vernal equinox it is divided into 12 portions, of 30° each, known as the signs of the zodiac. In former times great stress was laid upon the entrance of the sun into these several signs, which entrances occurred about a month apart. They now occur about the 20th of every month. In our times, when the superstitions connected with this subject have van-

ished, the entrance of the sun into the signs is no longer of importance (see ZODIAC). There are also 12 constellations, beginning with Aries, and ending with Pisces, which have the same names as the signs of the zodiac, and are scattered along its course. Two thousand years ago these constellations coincided pretty closely with the signs. But now, in consequence of the precession of the equinoxes, the two no longer correspond. The sign Aries is now located in the constellation Pisces; the sign Taurus in the constellation Aries, etc.

The ecliptic, together with circles drawn parallel to it on the celestial sphere, is frequently used as a reference circle to indicate the positions of stars and planets, the circles drawn through the poles of the ecliptic then taking the place of the hour circles already described. The co-ordinates of the object in this system are known as Longitude and Latitude, respectively, but it is to be noticed that these are not analogous to latitude and longitude on the earth since the equator is no longer the fundamental reference circle. This system is employed almost exclusively in orbit work and in celestial mechanics, but it is inconvenient for the purposes of practical astronomy.

The Time of Day.— It is in its relation to times and seasons that the results of astronomical science come into every household. Our daily round of activity and rest is determined by the earth's rotation on its axis, alternately bringing us under the sun, and then carrying us around until it is hidden from our sight. A century ago people used to set their clocks at 12 when the sun crossed the meridian. This moment, being the middle of the day, is noon properly so-called. But if a good clock is exactly regulated, and kept going all the time, it will not show noon at the true time. The reason is that the intervals of time between one noon and the next are not exactly the same. See TIME.

Bibliography.— The most extended general treatise on astronomy for the use of the general reader is Chambers' 'Astronomy' (3 vols., 8vo., London); briefer is Newcomb's 'Astronomy for Everybody'; Ball, 'Story of the Heavens'; Flammarion, 'Popular Astronomy'; etc.

SIMON NEWCOMB.

Revised by ERIC DOOLITTLE, *Professor of Astronomy and Director Flower Astronomical Observatory.*

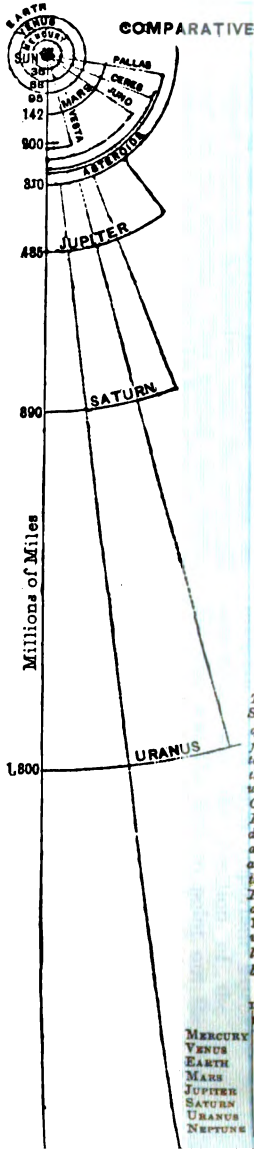
ASTRONOMY, History of. We may recognize four great periods in the history of astronomical knowledge. The first and most ancient is that in which no accurate observations were made, but in which men had a general knowledge of the apparent annual revolution of the sun, of the constellations and of the relation of the sun's annual course to the changes of the seasons. The next period was that of the celebrated Alexandrian school, so-called because Alexandria was the principal seat of its activity. This period was distinguished as that at which the first attempts were made at precise observation and measurement. It began three or four centuries before Christ. It is very remarkable that, at so early a period as this, men to whom all our modern science was completely unknown, had so far advanced in astronomical observation as to measure the obliquity of the ecliptic, determine the times of the equinoxes and detect their precession. The latter was done by a comparison of two methods of determining the length of the year, as measured by the sun's apparent revolution around the celestial sphere. Timocharis, who flourished about 300 B.C., determined the moment at which the sun crossed the equinox by means of an east and west line on the level sandy plains of Egypt, showing exactly where the sun rose or set. The day on which the point of setting in the west was exactly opposite that of its rising in the east marked the equinox, which could thus be determined within a few hours. The annual course of the sun can also be determined by the time which it takes to return to the same position among the stars after an annual apparent revolution. As the stars and sun cannot be seen at the same time, the adopted plan was to measure the distance of the sun from the moon before sunset, and after dark to measure the distance from the moon to some bright star. Allowing for the motion of the moon during the interval, the distance of the sun from the star would be known. In this way the curious discovery was made that the year as determined from the equinoxes was several minutes shorter than that determined from the stars. This discovery was made by Hipparchus through a comparison of his observations with those of Timocharis about 150 years before.

Eratosthenes, who flourished just before Timocharis, was enabled to estimate the size of the earth. This he did by noting that at the ancient town of Syene, in central Egypt, the sun was exactly in the zenith at the time of the summer solstice, so that the gnomons of the sun-dials cast no shadows, while at Alexandria the sun was 1/50 of a circumference south of the zenith. He therefore concluded that the circumference of the earth was 50 times the distance between Alexandria and Syene. The latter being 5,000 stadia, it followed that the circumference of the earth was 250,000 stadia. Although many different stadia were in use, the records of Pliny show that the stadium of Eratosthenes must have been a length of very approximately 516.73 feet; the resulting diameter of the earth is 7,788 miles,— a very fair approximation.

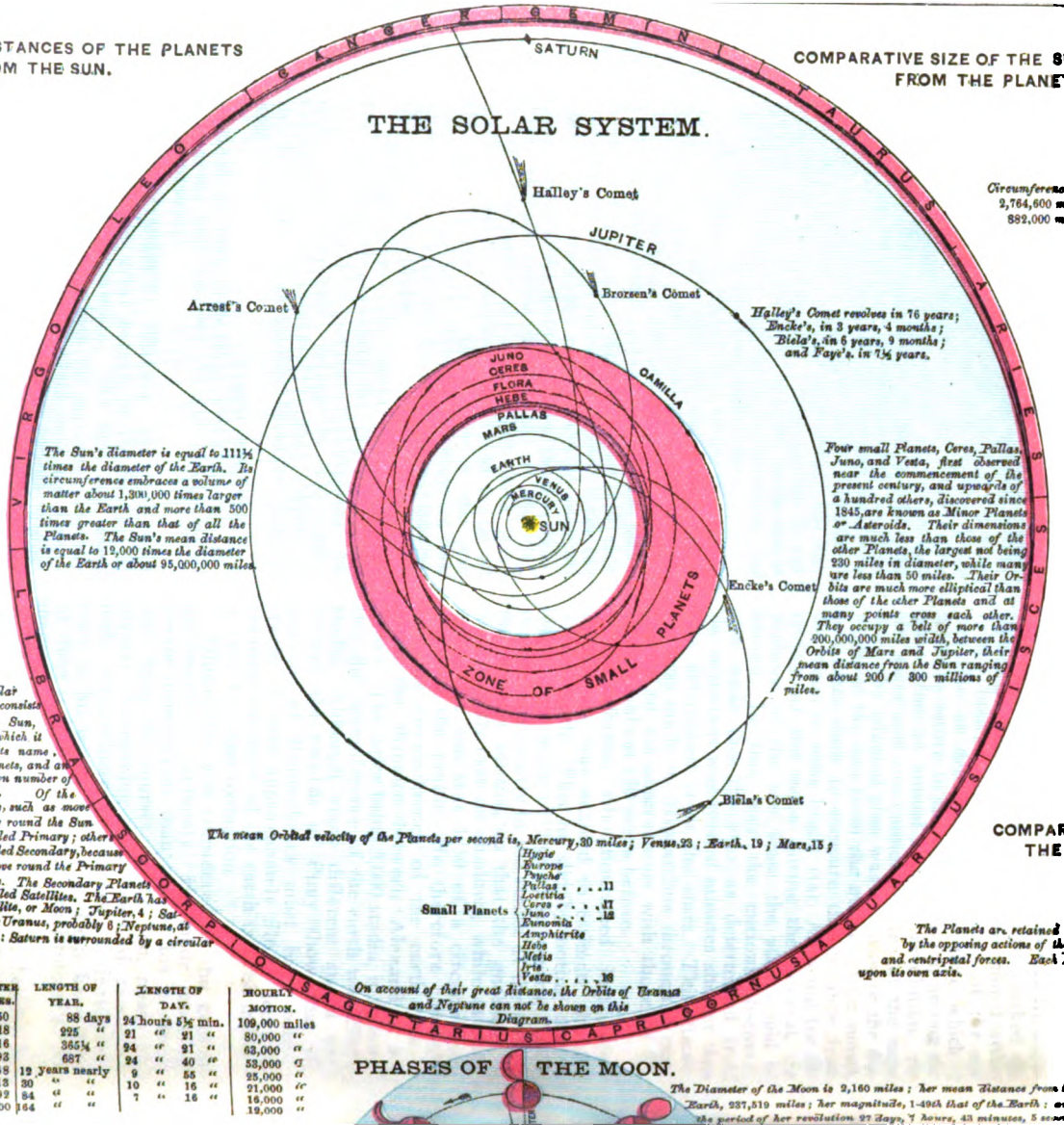
Hipparchus was considered as the greatest astronomer of antiquity. He made more accurate observations than any of his predecessors upon the courses of the sun, moon and planets, determining their times of revolution with extraordinary exactness. Unfortunately none of his works survive, and our knowledge of them is derived mainly from Ptolemy's 'Almagest.'

The celebrated Ptolemy (q.v.), besides being a practical astronomer, was accomplished as a musician, a geographer and a mathematician. His most important discovery in astronomy was the evection of the moon. He also was the first to point out the effect of refraction. He was the founder of the false system known by his name, and which was universally accepted as the true theory of the universe until the researches of Copernicus exploded it. The Ptolemaic system placed the earth, immovable, in the centre of the universe, making the entire heavens revolve round it in

COMPARATIVE DISTANCES OF THE PLANETS FROM THE SUN.



THE SOLAR SYSTEM.



The Sun's diameter is equal to 111½ times the diameter of the Earth. Its circumference embraces a volume of matter about 1,300,000 times larger than the Earth and more than 500 times greater than that of all the Planets. The Sun's mean distance is equal to 12,000 times the diameter of the Earth or about 95,000,000 miles.

Four small Planets, Ceres, Pallas, Juno, and Vesta, first observed near the commencement of the present century, and upwards of a hundred others, discovered since 1845, are known as Minor Planets or Asteroids. Their dimensions are much less than those of the other Planets, the largest not being 230 miles in diameter, while many are less than 50 miles. Their Orbits are much more elliptical than those of the other Planets and at many points cross each other. They occupy a belt of more than 200,000,000 miles width, between the Orbits of Mars and Jupiter, their mean distance from the Sun ranging from about 200 to 300 millions of miles.

The Solar System consists of the Sun, from which it takes its name, the Planets, and an unknown number of Comets. Of the Planets, such as move directly round the Sun are called Primary; others are called Secondary, because they move round the Primary Planets. The Secondary Planets are called Satellites. The Earth has 1 Satellite, or Moon; Jupiter, 4; Saturn, 8; Uranus, probably 6; Neptune, at least 1: Saturn is surrounded by a circular belt.

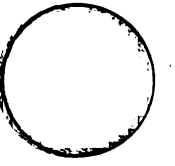
The mean Orbital velocity of the Planets per second is, Mercury, 30 miles; Venus, 23; Earth, 19; Mars, 15;

Small Planets: Hygie, Europa, Psyche, Pallas, Lœtitia, Ceres, Juno, Eunomia, Amphitrite, Hebe, Metis, Iris, Vesta . . . 16

On account of their great distance, the Orbits of Uranus and Neptune can not be shown on this Diagram.

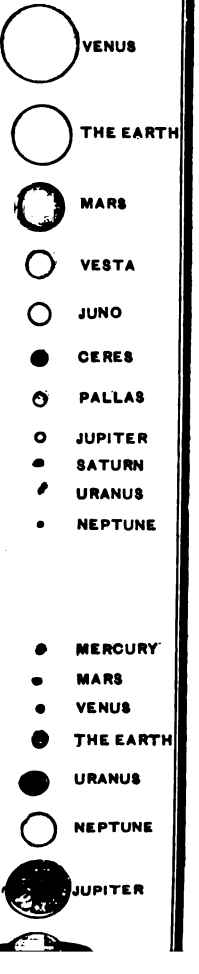
	DIAMETER IN MILES.	LENGTH OF YEAR.	LENGTH OF DAY.	HOURLY MOTION.
Mercury	3,150	88 days	24 hours 5½ min.	109,000 miles
Venus	7,718	225 "	21 " 21 "	80,000 "
Earth	7,916	365¼ "	24 " 21 "	68,000 "
Mars	4,093	687 "	24 " 40 "	53,000 "
Jupiter	85,968	12 years nearly	9 " 55 "	25,000 "
Saturn	79,013	30 " "	10 " 16 "	21,000 "
Uranus	34,292	84 " "	7 " 16 "	15,000 "
Neptune	37,000	164 " "		12,000 "

COMPARATIVE SIZE OF THE SUN AS SEEN FROM THE PLANETS.



As seen from MERCURY

Circumference of the Sun, 2,764,600 miles; the Diameter, 882,000 miles.



COMPARATIVE SIZE OF THE PLANETS.

The Planets are retained in their Orbits by the opposing actions of the centrifugal and centripetal forces. Each Planet moves upon its own axis.

PHASES OF THE MOON.

The Diameter of the Moon is 2,160 miles; her mean distance from the Earth, 237,519 miles; her magnitude, 1-49th that of the Earth: and the period of her revolution 27 days, 7 hours, 43 minutes, 5 seconds.

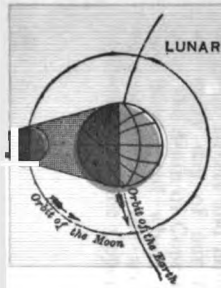
2,898 NEPTUNE

in her orbit round the Earth.

SATURN

ECLIPSES.

LUNAR ECLIPSE



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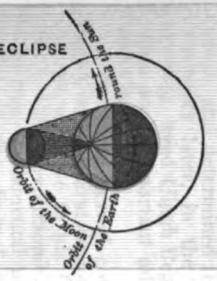
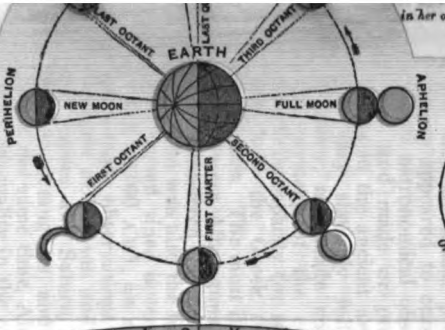
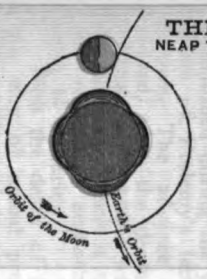
SOLAR ECLIPSE





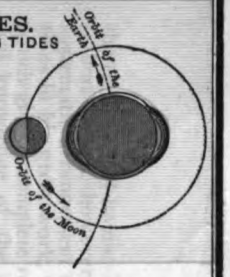
THEORY OF THE TIDES.

NEAP TIDES



SUN

SPRING TIDES



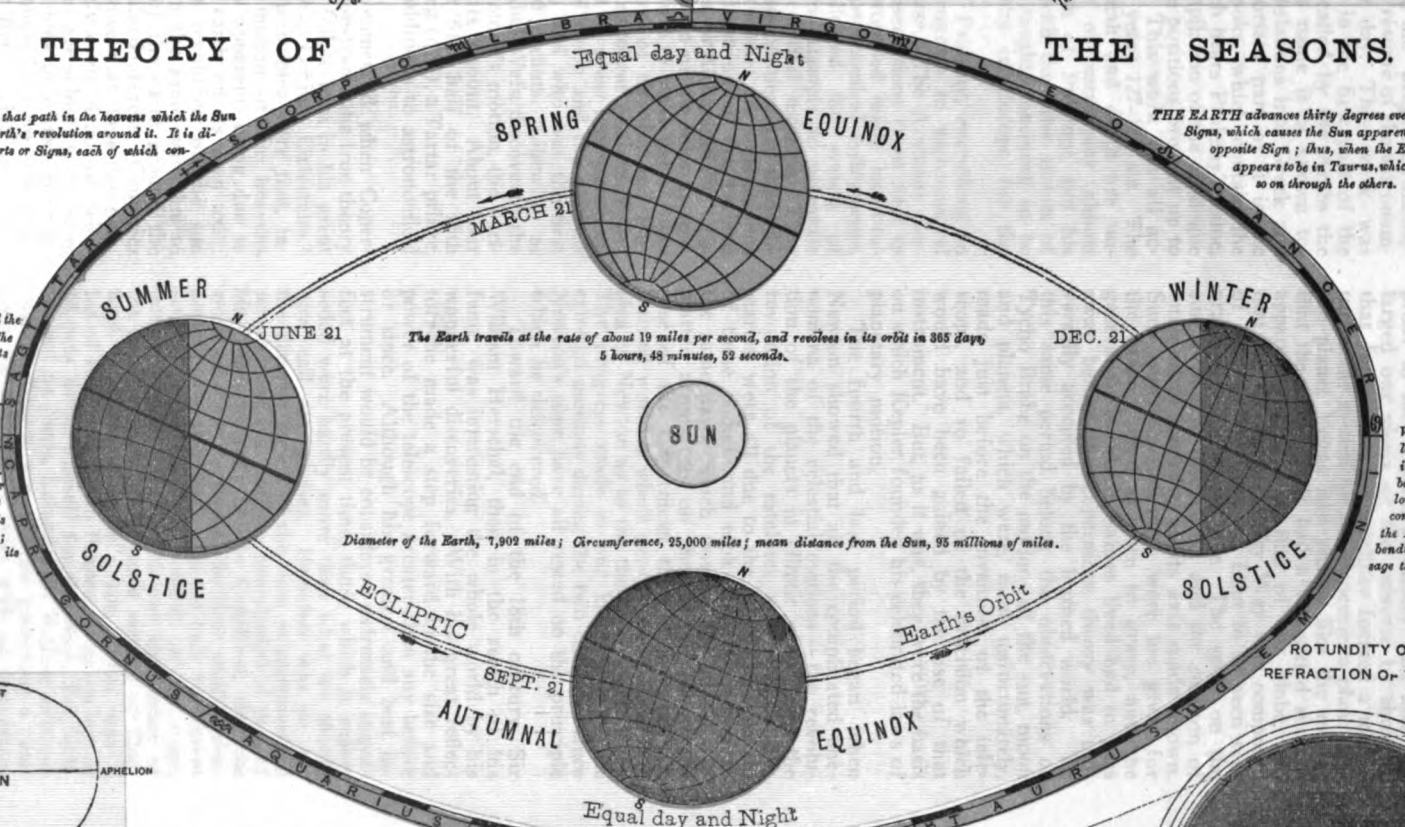
THEORY OF THE SEASONS.

THE ZODIAC represents that path in the heavens which the Sun seems to describe by the Earth's revolution around it. It is divided into twelve equal parts or Signs, each of which contains thirty degrees.

THE EARTH advances thirty degrees every month in each of these Signs, which causes the Sun apparently to do the same in the opposite Sign; thus, when the Earth is in Scorpio, the Sun appears to be in Taurus, which is the opposite Sign, and so on through the others.

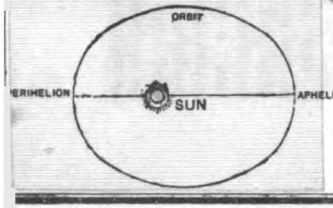
All the Planets move round the Sun from West to East. The paths in which the Planets move round the Sun are called their Orbits. These Orbits are not exactly circular, but elliptical, so that the Planets are nearer the Sun when in one part of their Orbits than in another. When the Earth or any other Planet is in that part of its Orbit nearest the Sun, it is said to be in its Perihelion; and when most remote, in its Aphelion.

When the Sun or the Moon's lower limb appears just resting on the Horizon, the entire body of either is actually below it, and would be quite concealed by the convexity of the Earth, but for the upward bending of the rays in their passage through the air.

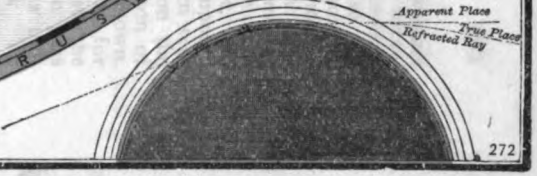


The Earth travels at the rate of about 19 miles per second, and revolves in its orbit in 365 days, 5 hours, 48 minutes, 52 seconds.

Diameter of the Earth, 7,902 miles; Circumference, 25,000 miles; mean distance from the Sun, 95 millions of miles.



ROTUNDITY OF THE EARTH AND REFRACTION OF THE ATMOSPHERE.



RAND, MC NALLY & CO., ENGR'S, CHICAGO.

the course of 24 hours. The work by which he is best known, however, is the collection and systematic arrangement of the ancient observations in his great work, the 'Megale Syntaxis,' which gives a complete résumé of the astronomical knowledge of the day. This work was translated into Arabic in the first part of the 9th century and was called by the Arabs the *Almagest*, and by this name it is known today in its various translations into Greek and Latin. The most important part of it is the seventh and eighth books, which contain the catalogue of stars which bears Ptolemy's name, though it is only a compilation of the catalogue of Hipparchus with the positions brought up to the time of Ptolemy. This work was all accomplished during the years 127–151 A.D. The dates of Ptolemy's birth and death are unknown. The advance of astronomy almost ceased, after the death of Ptolemy, and his 'Almagest,' together with the false system of the universe which it taught, continued to be the recognized authority in Europe for the next 14 centuries.

With the death of Ptolemy, everything in the way of actual progress in astronomical theory appeared to cease. The Arabians continued astronomical observations from time to time, and made or proposed many improvements in the ancient astronomical instruments, but they slavishly followed the system of Ptolemy, and made no attempts to penetrate the mystery of the celestial motions. They had little capacity for speculation, and throughout held the Greek theories in superstitious reverence. The most illustrious of the Arabian school were Albategnus, or Al Batani (880 A.D.), who discovered the motion of the solar apogee, and who was also the first to make use of sines and versed sines instead of chords; and Ibn-Junis (1,000 A.D.), an excellent mathematician, who made observations of great importance on eclipses of the sun and moon and the motions of Jupiter and Saturn, and who was the first to use cotangents and secants. Likewise, at about the same time, Abul Wefa discovered the third inequality in the moon's motion, the variation, and determined its amount. About four centuries later, in the first half of the 15th century, lived Ulugh Beg (q.v.), a Tartar prince, who made important additions to astronomical knowledge.

The third period commenced when Copernicus, in 1543, first demonstrated the true theory of the universe to his fellow men in his great work 'De Revolutionibus Orbium Cœlestium.' His two fundamental principles were that, instead of the diurnal motion of the heavens being real, it was only apparent, being due to the revolution of the earth on its own axis; and that the apparent revolution of the sun around the sky was, in the same way, due to the actual revolution of the earth around the sun, which latter remained at rest. Centuries of observation have shown that these two principles explain so exactly every detail of celestial phenomena that they are subject to no more doubt than our conclusions as to the arrangement of streets and houses in a city which we see every day of our lives. Half a century after the death of Copernicus flourished Galileo and Kepler, of whom the first invented the telescope, while the second demonstrated the correctness of the Copernican theory, and also showed that the planet Mars revolved around the sun in an ellipse with the sun in its focus.

The invention of the telescope added another proof to the Copernican theory, and also enlarged our views of the universe by showing that Jupiter and his satellites formed a miniature solar system on the Copernican plan; that the planet Venus had phases like the moon; that the moon itself had a variegated surface apparently similar to that of our globe, and that the wonderful Milky Way was composed of innumerable stars too faint to be seen separately by the naked eye. The spots on the sun were also discovered, and the rotation of our central luminary on its axis made known. Such enormous advances were too great for the human mind at once to grasp, and the generation in which Galileo lived had to pass away before the Copernican theory was universally accepted by the learned world. To this same period belong the observations of Tycho Brahe on the motions of the sun, moon and planets, which were, most unfortunately, made just before the invention of the telescope, and so failed of the precision which would have been gained by the use of that instrument. But, as it was, they were the basis on which Kepler founded his celebrated laws of planetary motion.

The fourth and last period began when Newton showed that all the complicated phenomena of the celestial motions — the revolution of the planets in elliptic orbits, and the revolution of the satellites around their primaries, were all due to the mutual gravitation of these bodies, and took place according to the same laws which govern the motion of matter around us on the earth. As in the case of the Copernican theory, it took the learned world a whole generation to grasp the idea of Newton as to the theory of gravitation. The progress made in our knowledge of the celestial motions during the two centuries since Newton's time have all rested on the principle which he discovered.

Toward the end of the 18th century, Sir William Herschel, then in the zenith of his fame, was interesting the whole world by his wonderful discoveries. With his great reflectors he made a step forward in the size and power of the telescope greater than any before or since. Although his greatest and best instrument would be considered extremely imperfect at the present time, those which it superseded were hardly more than what we should now call spy glasses. Herschel was so far the greatest figure of the time in astronomical science, and his work so overshadowed that of his contemporaries on the Continent, that the work of everyone else at the time seems unimportant in comparison. Yet not only were great successors of Herschel coming on the stage, but important additions to our knowledge of the heavens were being made outside of England. William Herschel's son, John, was a lad of eight years. In France, Arago, a boy of 14, was fitting himself for the École Polytechnique. At Paris, Lalande, the leading astronomer of France, was actively preparing a catalogue of the fainter stars with an instrument which would now be consigned to the junkshop. But it was the first attempt that had ever been made to determine accurately the positions of the many thousand telescopic stars invisible to

the naked eye, and in consequence the 'Histoire Céleste' is still one of the classics of the astronomical investigator. In Germany, Olbers combined the professions of physician and astronomer, and Bessel, a youth of 16, was clerk in a mercantile house.

The first day of the century was marked by a discovery of capital interest and importance. The wide gap between the planets Mars and Jupiter had been a source of wonder, and the conviction that there must be a planet in it had become so strong that an association of astronomers was formed to search for it. But, on 1 Jan. 1801, before they got to work, Piazzi, the Italian astronomer of Palermo, found Ceres. The year following Olbers discovered Pallas, and propounded his celebrated theory that the newly-formed bodies were fragments of a shattered planet, more of which might be found. This anticipation was amply justified by the result, though the theory of a shattered planet has long been rejected. By 1868 the number reached 100. When the sky was systematically watched 100 more were found. When the process of photographing the stars was perfected, so many new ones were found on the photographic plates that it is almost impossible to follow them up. About 750 have had their orbits mapped out. See ASTEROIDS.

In this country, David Rittenhouse, almost the only American of Revolutionary times who has a place in scientific history, had been dead four years when the century began, and there was no one to take his place. He was one of the committee of the American Philosophical Society that made an extensive and well-planned set of observations on the transit of Venus in 1769. The first American after the Revolution to acquire eminence in any department of astronomical science was Nathaniel Bowditch. A Boston ship-captain by profession, he first prepared his 'Navigator,' the standard work of the sailor through most of the century. He mastered the great work of Laplace, and made it accessible to students by a translation and commentary explaining the processes in detail. So far as practical astronomy was concerned, it might be regarded as non-existent among us during at least the first third of the century. We know little more of it than that Robert Treat Paine, grandson of the signer of the Declaration of Independence, used to compute eclipses and publish the results in the 'American Almanac,' and the Boston *Advertiser*. About 1840, Dr. Lardner paid a visit to this country and remained several years, delivering public lectures, which, though not of a high order when measured by the standard of today, were much above any which Americans had then heard.

During the first half of the century, the advance of astronomical science consisted principally in a form of development which goes on without any striking discovery, and has therefore little interest for the general public. When bright comets appeared they were carefully studied by observers, at the head of whom were Bessel and Olbers. It was thus found that the tail of a comet was not an appendage carried along with it, like the tail of an animal, but merely a tenuous stream arising from it and apparently repelled by a force residing in the sun. The discovery of telescopic comets by observers, here and there, continually added to the number of these bodies known. Most of them were found to be moving in such orbits that they would require thousands of years, perhaps tens of thousands, to return to the sun, if, indeed, they ever reappeared. But this, though the general rule, is far from being universal. From time to time comets were found moving in closed orbits and performing their revolution in periods of a few years, mostly between 3 years and 10.

One of the noteworthy discoveries of the third quarter of the century was that of the relation between comets and shooting stars. The first discovery of this relation came about in a curious way. The researches of H. A. Newton and others had made it quite clear that shooting stars were due to the impact of countless minute bodies revolving around the sun in various orbits and now and then encountering our atmosphere. It was also known that the great November meteoric showers must be due to a stream of such bodies. One astronomer computed the orbit of the November meteors; and another quite independently published the orbit of a comet which appeared in 1866. A third astronomer, Schiaparelli, noticed that the two orbits were practically the same. The conclusion was obvious. The minute bodies which caused the shower moved in the path of the comet and were portions of its substance which had from time to time separated from it. The disappointing failure of the shower in 1899 and 1900 can have but one cause — a small change in the orbit of the meteoric swarm caused by the attraction of the planets. Nor has the comet associated with them shown itself; it was perhaps dissipated like that of Biela's. Apart from this, the question of the constitution of comets is still not completely solved. Their spectrum is that of a body which shines by its own light, but we are not certain whether this light principally emanates from matter in a radiant condition or whether it is due (at least in large part), to electrical discharges through the enveloping gases between the particles of the comet. But it is very probable that all comets are vast cloudlike swarms, made up of meteoric particles, cosmic dust and matter in a radiant condition, the whole immersed in and surrounded by the gases whose spectra it is that we obtain in our instruments. The brighter comets may have a more or less massive nucleus. Yet it is not certain that the nucleus is entirely opaque. In 1882, the astronomers at the Cape of Good Hope enjoyed the opportunity of seeing a comet enter on the disc of the sun. Unfortunately, the sun disappeared from view a very few minutes afterward. But not a trace of the comet could be seen on the sun as a spot. It was seemingly quite transparent to the solar rays. That the fainter comets have no nucleus and are merely composed of a collection of foggy particles seems certain. See COMET.

The Greenwich Observatory was taken in charge by Airy in 1834. He immediately instituted a great improvement in its organization and work, but it was not till 1850 that he acquired for it new instruments of great importance. He was the founder of what has sometimes been called the Greenwich system: the astronomers of an institution taking a part like those of soldiers in an army, making all their observations on a plan prescribed by the author-

ity and rarely using their own discretion in any way. The mathematical theory of the motions of the planets, and especially the moon, received its greatest improvement for the hands of Hansen, born about 1795. He may fairly rank as the greatest of celestial mechanicians since the time of Laplace. Toward the middle of the century, he prepared the first tables of the moon which could satisfy the requirements of modern astronomic theory. These were published by the British government in 1857, and have now formed the basis of astronomical ephemerides for nearly half a century. The most striking event of the mid-century period, and one which in the popular mind must long hold its place as among the greatest of intellectual achievements, was the computation by Leverrier of the position of an unknown planet from its attraction on Uranus. The speedy discovery of the planet on the very night it was first looked for was, for the public, a proof of the absolute correctness of gravitational theories that surpassed all others. It was as a first and bold attempt to sail into an unknown sea; yet, as in the case of Columbus and the Atlantic, its repetition would not now be generally considered a difficult matter. With the discovery of Neptune and with the advance in the art of astronomical observation, improvements in the theories of the movements of the planets were necessary. The greatest step forward in this direction was taken by Leverrier. Among the results of his work was the discovery that the perihelion of Mercury moves more rapidly than it should under the influence of gravitation. This excess of movement has been abundantly proved by observation since his time, but its cause has only very recently been plausibly explained. (See ASTRONOMY, THEORETICAL). As a general rule, it may be said that during the last half century the Germans have been the leaders in astronomical research. Their work on the subject has been more voluminous than that of any other nation. The leading astronomical journal of the world is still that of Germany. But when we consider not quantity of work, but the special importance of particular works, precedence has, from one point of view, passed to America. While, perhaps, we still have fewer students pursuing astronomy in the United States than they have in Germany, the number among us who have acquired the highest distinction and most skilfully made applications of this science is greater than in any other country. The rapidity of progress from small beginnings is very remarkable.

In 1832, Professor Airy delivered, before the British Association for the Advancement of Science, an address on the progress of astronomy, which soon acquired celebrity. The state of astronomy in different countries was reviewed. America was dismissed with the remark that he was not aware of any observatory existing in that country. In the revival of astronomy among us and its advance to its present position in popular favor, one agency has not been esteemed so highly as it deserves. Contemporaneous with the visit of Dr. Lardner were the lectures of Prof. Ormsby M. Mitchel. With unsurpassed eloquence he explained the wonders of astronomy to audiences intensely interested in the novelties of the subject. From a scientific point of view the lectures were probably not of a high order, nor could it be said that Mitchel himself, active and enthusiastic though he was, was a profound astronomer. Yet it may well be said that to him is due the ability of our astronomers since that time to secure the public support necessary to the erection of the fabric of their science. A few years after Airy's address small college observatories were founded at Williams College and at the Western Reserve College, Ohio. These were doubtless a stimulus to students, but can hardly have added to astronomical science. When the Wilkes Exploring Expedition was being organized it was found necessary to have a continuous series of observations made at home during the absence of the expedition which compared with those made on the ships would enable the navigators to determine the longitudes of the lands they discovered. A little wooden structure, erected by Captain Gilliss for this purpose, on Capitol Hill, Washington city, was in some sort the beginning of our National Observatory. The actual foundation of the latter was almost contemporaneous with that of the Harvard Observatory, both being commenced about the year 1843. The Harvard Observatory was placed under the direction of William C. Bond, who had, for many years, made observations, first at his own house in Dorchester, and then on top of a house at Cambridge. At Washington the Naval Observatory was placed under the charge of Lieutenant Maury. After getting its instruments in operation, he devoted himself almost entirely to those researches on ocean currents, which, so long as the commerce of the world was carried on mostly in sailing vessels, were of the first importance. But the institution soon acquired astronomical celebrity in other ways. Here Sears Cook Walker made the first thorough investigation of the orbit of Leverrier's newly-discovered planet, and showed that it had been twice observed by Lalande as far back as 1795, but without its character being suspected. Here also the device of recording the transits of stars by means of the chronograph and determining the longitude of places by telegraph found their first application. New observatories, some founded in connection with colleges, others by private individuals, now sprang up rapidly among us in every quarter. Twenty-four were enumerated by Loomis in 1856. What figure the number has now reached it is impossible to say; in a catalogue of the observatories of the world compiled in 1907 by Strobant, of the Royal Observatory of Belgium, there are included no less than 107 from the United States.

Beside the very important Naval Observatory, above referred to, the four largest observatories of our country are (in the order of their establishment), the Harvard Observatory, at Cambridge, Mass., the Lick Observatory at Mount Hamilton, Cal., the Yerkes Observatory of the University of Chicago (situated at Williams Bay, Wis.) and the Carnegie Solar Observatory at Mount Wilson, Cal. At each of these there are many astronomers, and many different lines of investigation are simultaneously carried on, but it should not be overlooked that American astronomy is also being advanced by many smaller institutions. Several of these are of sufficient size to be also classed as great observatories, but their energies

are wisely concentrated along but one or two lines of specialized work. At institutions where the equipment and personnel are still smaller, but one kind of research is usually undertaken. A great part of the advancement of the science throughout the world is due to such, somewhat smaller, observatories when their resources are devoted to fundamental work, although the total amount accomplished by any one of them is less than that of the larger institutions because their field of research is necessarily less diversified.

The Harvard Observatory, while a respectable institution from its foundation and made famous by the work of the Bonds, had never commanded the means necessary to prosecute astronomical research on a large scale. When Pickering assumed the directorship in 1875, he devoted his energies to those branches of research which are now known under the general term of astro-physics, being concerned with the physical constitutions of the heavenly bodies rather than with their motions. The extension of his work was made possible by very large additions to the endowment of the observatory. It thus became one of the best-supported institutions of the kind in the world. Photometry and spectroscopy have been its main subjects. With the aid of a branch established in Arequipa, Peru, the magnitudes of all the stars in the heavens visible to the naked eye, as well as many fainter ones, have been determined. A system of constantly photographing the heavens is also here carried on; the tens of thousands of plates thus far secured have many times proved of great value for reference, constituting, as they do, a permanent record of the appearance of the face of the sky.

The success of the Lick Observatory in a different, yet not wholly dissimilar, direction must be regarded as one of the most extraordinary developments of our time. Commencing work about the beginning of 1888, under the direction of Holden, and supplied with the greatest telescope that human art had then produced, the observations of Burnham and Barnard excited universal interest, both among astronomers and the public. The discovery of a fifth satellite of Jupiter was made there by Barnard in 1892, and very recently two additional satellites of this planet were discovered at the same observatory. Later, the optical discovery of the companion of Procyon, an object known to exist from its attraction on that star, was made by Schaeberle. But its most epoch-making work is due in still more recent years to Campbell, by measurements of the motion of stars in the line of sight with the spectroscope, who, armed with the best spectrograph that human art could make, the gift of D. O. Mills, has, by the introduction of every refinement of his method, brought into these measures a degree of precision never before reached. The cases of variable motion, as found by him, are so numerous as to indicate that isolated stars may be the exception rather than the rule among the brighter stars. As to the host of very faint stars, the detection of the irregularities in the motion of these is as yet far beyond the power of any spectroscope.

The construction of the great Yerkes Observatory was begun in 1892 and completed in 1897. Here there is mounted an equatorial telescope of 40 inches aperture, the largest refracting telescope in existence. This, together with the numerous smaller instruments, is devoted in part to spectroscopic work and in part to the accurate measures in astronomy of position. Under the former head, most important and fundamental researches have been continuously prosecuted in the spectra of the stars, while under the latter are most accurate determinations of the parallaxes of numerous stars, both by the photographic and the visual methods, and micrometric measures and discoveries on double stars and other heavenly bodies. The first director was George E. Hale, who was succeeded in 1905 by E. B. Frost, with whom are associated Burnham, Barnard and many other astronomers.

The Mount Wilson Solar Observatory of the Carnegie Institution of Washington was begun in 1904, with George E. Hale as director; it is situated on the summit of Mount Wilson, 12 miles from Pasadena, Cal. Though primarily designed for the spectroscopic study of the sun, many other lines of work are also prosecuted; the spectroscopic studies of the stars and the unexcelled photographs of nebulas here secured are especially noteworthy. (See ASTRONOMICAL PHOTOGRAPHY). The peculiar and unusual forms of some of the telescopes designed for the special work of this observatory aroused much interest among astronomers. There is a reflecting telescope of 60 feet focal length which lies horizontally, and two refracting telescopes of which the lenses are placed on the summits of vertical towers, 60 and 150 feet in height, respectively, while the spectroscopes and photographic apparatus are placed in wells below the towers. The second tower telescope, because of its great focal length, forms an image of the sun 17 inches in diameter. There is also a 60-inch reflecting telescope, and a 100-inch mirror, which last, after many failures arising from the difficulty of casting so large a disc of glass, has now been figured, and mounted for use.

Bibliography.— In French, we have the monumental works of Delambre; in English, Clerke, Agnes M., 'Popular History of Astronomy in the 19th Century'; Grant, Robert, 'History of Physical Astronomy.'

SIMON NEWCOMB.

Revised by ERIC DOOLITTLE, *Professor of Astronomy and Director Flower Astronomical Observatory.*

ASTRONOMY, Practical. The instruments of observation used by the working astronomer are made up mainly of various combinations of three appliances. These are the telescope, the graduated circle and the clock

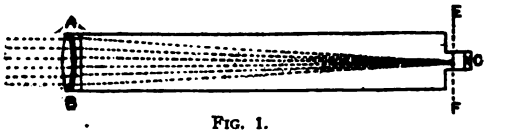
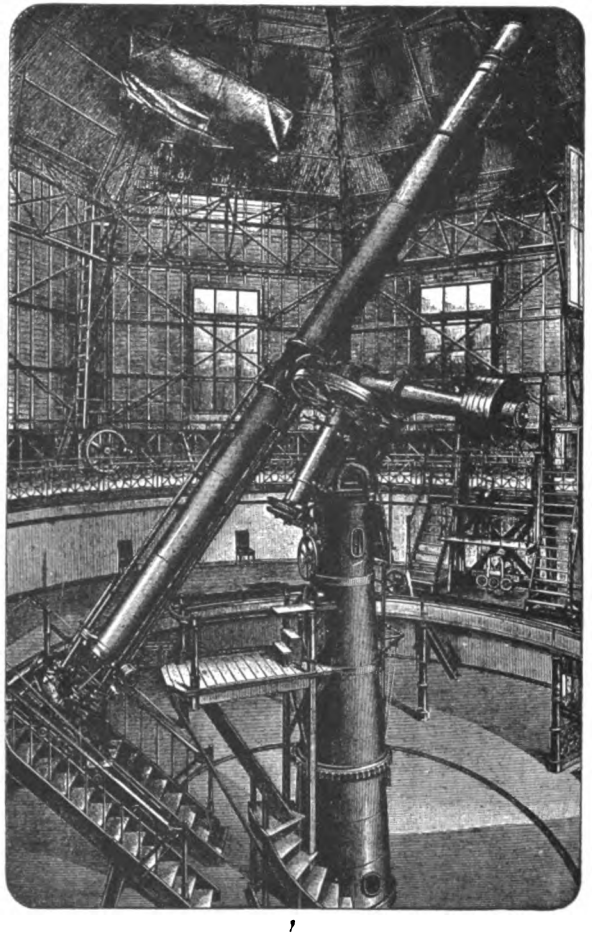


FIG. 1.

(for the principles of the first see TELESCOPE). With the clock is associated the chronograph as part of a combination for measuring time. Many auxiliary appliances are also brought into use of which the micrometer and the spirit level are the most important. The usefulness of the telescope in measurement does not arise solely from its enabling the observer to see objects otherwise invisible. A telescope with



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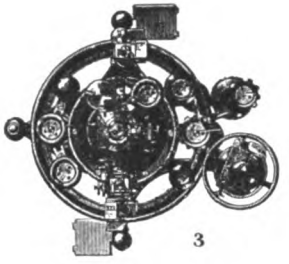

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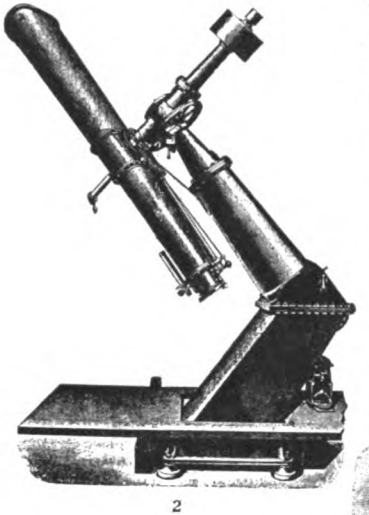

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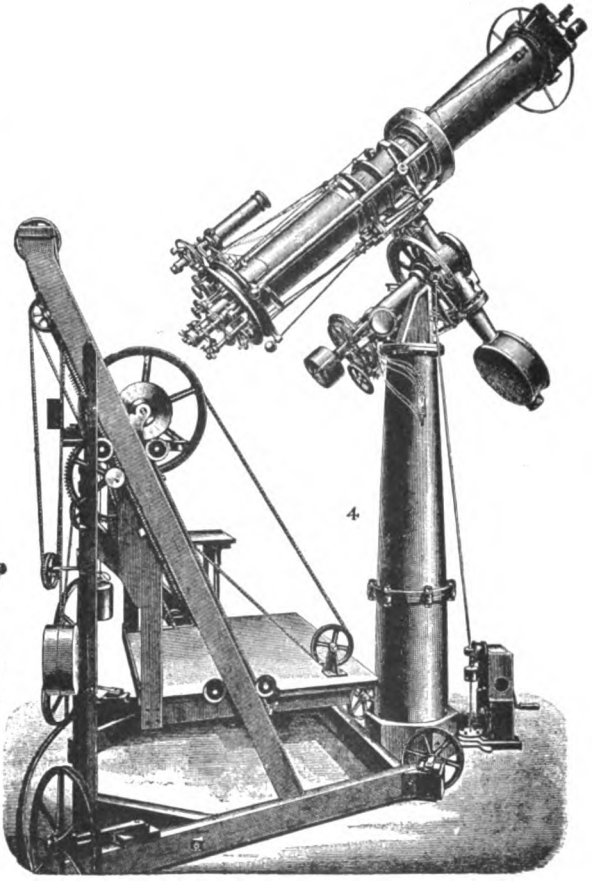


4

1 Equatorial in the Observatory at Pulkova

2 Photographic Refractor

3 Eye-end of No. 4

4 Heliometer

no magnifying power at all would still enable him to determine the directions of the heavenly bodies at any moment with greater accuracy than would otherwise be attainable. The prin-

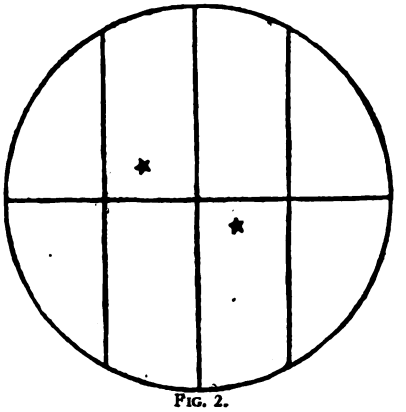


FIG. 2.

ciple on which the telescope is used in celestial measurement will first be explained. Let Fig. 1 represent the section of a telescope; A B being the object glass, and C the eye-end, where the rays from a star are brought to a focus. The lines converging to the plane E F represent the rays of light from a star reaching the focus. Here they form an image of the star, which the observer sees by looking into the eye-piece at C. The plane, of which the dotted line E F is a section, passing through the focus at right angles to the telescope, is called the focal plane. By changing slightly the direction in which the telescope is pointed, the rays may come to a focus on any point in this plane not too far from the axis or central line of the telescope. In the focal plane is placed a system of very fine threads which the observer sees when he looks into the eye-piece. These threads are generally made of fibres of spider-web, a substance so well adapted to this purpose that nothing better has yet come into use. To fix the ideas we shall suppose several cross threads; then the observer by looking into the telescope may see the stars and the cross-threads as represented in Fig. 2. Here we have the images of two stars quite near the crossing point of the threads. The observer moves the telescope until one of the stars is seen exactly at the point of intersection of the two threads. The fundamental principle in the use of the telescope is that when this occurs the star is apparently situated exactly on a straight line passing through the cross-threads, and the centre of the object glass. This line is called the line of sight of the telescope.

Now, let the observer move the telescope until he finds another star, whose image he brings upon the cross-threads. The angle through which he has moved the telescope from one star to the other, supposing the two stars to be at rest, will then be precisely the angle between the rays of light coming from the two stars. If, then, any system is adopted of determining through how many degrees, minutes, etc., the telescope has moved, the angular distance between the stars is known. The studious reader will remark that, owing to the rotation of the earth, the image of a star seen in a fixed telescope is continually moving across the field of view. To explain the principle we must, however, leave this motion out of account, or suppose it allowed for.

We have next to show how a large angle through which the telescope may be moved is measured. This is done by means of the graduated circle, a representation of which is shown in Fig. 3. It will be seen that the rim of the circle is divided up into degrees by fine lines as represented in the figure, where, however, only every fifth degree is marked. In the instruments actually used in astronomy, not only is every degree marked, but in the circles for the finest observations the degrees are still further subdivided into spaces of 5′, 3′, or even 2′. Since there are 360° in a circumference, it follows that in a division to 2′ there will be 10,800 of the graduations, or fine marks, on the circle. These marks must all be as nearly equidistant as human art can make them, and the problem of doing this, together with that of making them so fine and sharp that they can be used in the most precise measurement,

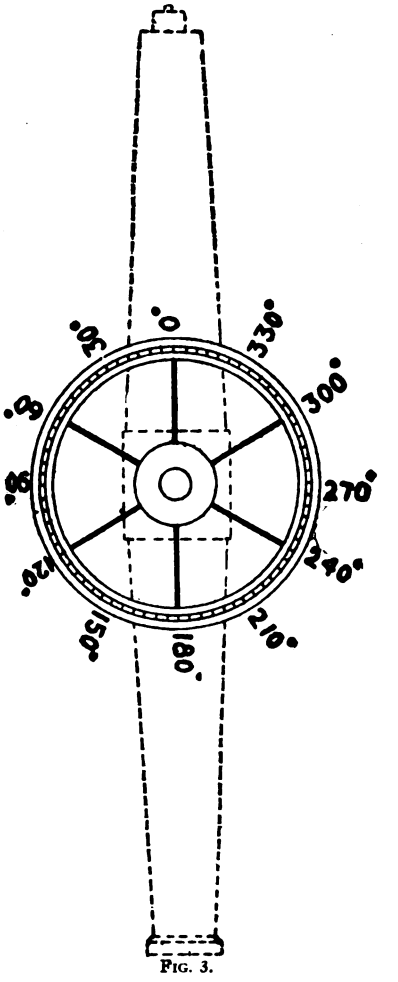


FIG. 3.

is one of the most difficult with which the instrument maker has to deal. The way in which the divided circle is used to measure the angular motion of the telescope is shown by

the dotted outline of the latter. The circle is attached to it so that both move on an axis concentric with the circle and perpendicular to its plane. Then, when the telescope is turned on this axis, the circle turns with it as a grindstone does on its axis. The distance through which

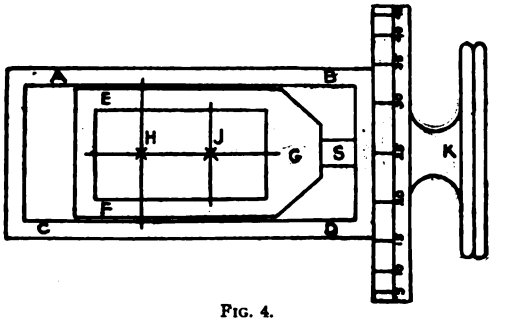


FIG. 4.

telescope and circle are turned is then measured by means of the graduations. To show how this is done, other appliances must be described.

Instead of two stars being far apart, so that the telescope has to be moved, they may be alongside of each other, as in Fig. 2; then, the observer, by moving the cross-threads from one star to the other, and measuring the amount of the motion, can determine the angular distance between the stars, and their relation to each other. This is done by a micrometer, one kind of which will now be described.

The Filar Micrometer.—This adjunct is so called because an essential part of it consists in fine threads of spider lines stretched across the field of view, as already described. The aim of its construction is to admit of these threads being moved in a direction at right angles to their length, by a very fine screw, so that the space over which they pass may be measured by the turns of the screw. The principal appliances for effecting this are a fixed frame, A B C D, Fig. 4, in which slides another frame, E F G, moved by a fine screw at S. Across this inner frame is stretched the spider line J, and across the fixed one the spider line H. To the head of the screw is attached a cylindrical rim, which has 100 or some other number of divisions cut upon it. An index mark serves to show how far the screw is turned. An apparatus for measuring the number of turns of the screw is attached, but need not be described here. Then when the observer turns the screw, the movable frame of the spider lines is slowly carried along with it. The position of the spider lines as they move is then shown at every moment by the number of turns of the screw and the fractions of a turn. To show the accuracy with which this can be done, we remark that the screws used by astronomers may have 100 or even 125 turns to the inch. Then, each revolution of the screw, as read off on the head, measures to a motion through this space. There being 100 graduations on the head, each graduation may measure the motion of 1-10,000 of an inch. But the observer may estimate the tenths between the divisions, thus carrying his measurements down to the 1-100,000 of an inch. Beside the movable spider line across the frame, fixed spider lines may also be stretched across the fixed frame. Then we shall have two systems of spider lines, one movable and the other fixed. The relation of each to the other is measured by the turns of the screw.

To determine the exact position of the graduated circle, a filar micrometer O is attached to a microscope of the form shown in Fig. 5, and the latter is finally fastened to a fixed frame in such a position that, when the observer looks into the microscope, he sees the graduations on the circle magnified as many times as necessary, and also the threads of the micrometer. The microscope being fixed remains at rest while the circle turns. If the instrument were geometrically perfect in every respect, one reading microscope would answer the purpose; but, as the circle cannot be centred with mathematical exactness, pairs of microscopes are used which are at opposite ends of diameters of the circle. For example, when the graduation 15° 20′ is brought under one microscope, the graduation 195° 15′ would be under the opposite one. It is customary, for greater precision, to have two such pairs at right angles to each other, or four microscopes in all.

To determine the position of the circle, and hence the direction in which the telescope attached to it points, the observer looks into one of the microscopes and fixes upon some graduation of the circle, turns the micrometer screw till a spider line, or the middle of a pair of lines, is central on the graduation, and then reads the indication of the head of the screw. It will be noticed that in Fig. 5 the mark 21° is central under the miscroscope. By pointing his telescope on one star after another and reading the microscope in this way, noting

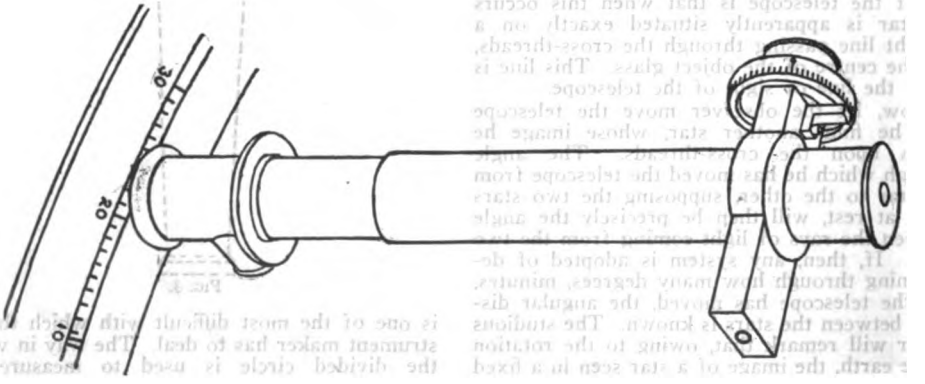


FIG. 5.

on each occasion what graduation is read, the distance through which the telescope is moved, and therefore the angles between the stars, are measured with the highest precision.

The Clock.— The astronomical clock does not differ greatly in its construction from the ordinary clock. Its arrangement and the numbers on its face are, however, adapted to the measures of time used by astronomers. Mean solar time, which is the time we make use of in the affairs of daily life, is also used by the astronomer with a slightly different arrangement. Instead of the hours being designated as A.M. and P.M., the astronomer counts through the whole 24 hours. Moreover, the count does not begin at midnight, but at noon, which is therefore the commencement of the astronomical day. For purely scientific purposes this is the natural time to begin the day, because it is determined by the passage of the sun across the meridian. Therefore, any day of the month, as used by the astronomer, continues until noon of the following day, when a new day begins. For this reason the hour hand of his clock only makes one revolution in the 24 hours, the hours being numbered from 0 to 23. The astronomer makes use of a second system of time, entirely different from that used in daily life, being based on the apparent diurnal movement of the stars. We have explained, in the preceding article (ASTRONOMY) that the time between two passages of the same star over the meridian of a place is not quite 24 hours, but nearly four minutes less. This is the true time of rotation of the earth on its axis, because, in consequence of the advance of the earth in its orbit, it must go through a little more than its true revolution in order that the meridian of any place on its surface — that of Washington for example — may again pass directly under the sun. The astronomer therefore uses a "sidereal day," which is shorter than the day determined by the sun in the proportion 365.24:366.24. This day is divided into 24 sidereal hours, and each hour into sidereal minutes and seconds, according to the usual system. A sidereal clock is regulated so as to gain about 3 m. 56 s. every day on our ordinary clocks and, in this way, keep time with the apparent diurnal movement of the fixed stars. It is so set that it shall read 0 h., 0 m., 0 s. at the moment when the vernal equinox crosses the meridian. As any of us, by looking at the clock, can tell, by the time of day, whether the sun is in the east, south or west, so the astronomer, by his sidereal clock, can tell in what part of its apparent diurnal course any star may be situated. For example, at 5 h. he knows that the constellation Auriga is on the meridian, and at 18 h. 34 m. that the beautiful Lyra is crossing the meridian.

The Chronograph.— There are two principal methods by which the astronomer notes the time of occurrence of an instantaneous phenomenon to a fraction of a second. On the older system, which is not without its advantages, the observer, looking at his clock, counts its beats until the occurrence of the phenomenon he is to observe. We may take, as an example, the occultation of a star by the moon. He sees the limb of the moon approaching the star until it is clear that, in a few seconds, it is going to pass over it and hide it from view. Then looking at the clock, he listens to the seconds, mentally counting the number of each beat. At length, there is a certain beat of the clock when the star is not yet hidden, while before the next beat the star has disappeared from view. He estimates how many tenths of the interval between the beats of the clock had elapsed when the star disappeared, and records the hours, minutes, seconds and tenths in his note-book. The skilled observer will seldom be more than a few tenths of a second in error in this estimate. It requires long practice, and much natural aptitude, to be able to make an accurate observation in this way. The method has also the inconvenience that there is no permanent record except that which is written down at the moment, so that, if the observer has made an error of any kind, he has no direct way of detecting it except by subsequently discovering that something must be wrong. This difficulty is avoided by means of a chronograph. In the form commonly used, the chronograph consists essentially of a cylinder, generally about eight inches in diameter and one or two feet in length, revolving on its axis by clock work at the rate of one turn a minute. Around the cylinder is stretched a sheet of paper, which is carried with it in its motion. The sheet is pressed by a pen, pencil or other point, so as to leave a mark on the paper as the cylinder revolves. The pen is carried by a little carriage moving slowly forward from one end of the cylinder to the other at a rate of about one-tenth of an inch, or a little more, in a minute. Consequently, the point describes a spiral line on the paper as the chronograph goes through its successive revolutions, until the pen arrives at the farther end of the cylinder. This may take a period of two, three or four hours, according to the adjustments. The pen is connected with an electro-magnet, the current around which passes through the works of the clock. The arrangement is such that at every beat of the clock, or sometimes at every alternate beat, the electric current is either closed or broken. With each closing or breaking of the current a slight motion is given to the pen so that the seconds are marked on the paper on the revolving cylinder. The same or another current also passes through a key held in the hand of the observer. When the latter sees the moment of the phenomenon he is to note approaching, he holds the key in his hand, and presses it at the exact moment to be recorded. A motion is thus given to the pen, and the position of the signal on the paper among the signals given by the clock shows the moment to a fraction of a second at which the signal was given.

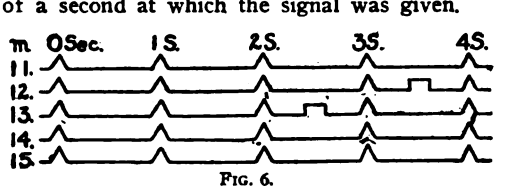


FIG. 6.

Different systems are used based on this general principle. There are various ways in which the pen marks the clock beats on the paper. In that mostly used in this country the pen is not raised from the paper, but is given a sudden lateral jerk, producing a notch in the line, as shown in Fig. 6, which is a copy of a small portion of a chronograph record. On

another system the pen simply makes dots on the paper at each beat of the clock. Sometimes the current passes around the electric magnet all the time except at the instant a signal is made. Then one and the same electric circuit is used for both the clock and the observer. Sometimes the clock only makes the circuit at the moment of its beat; then the circuit at the command of the observer is a second one, which he makes by pressing the key. The main point in all systems is that the beginnings of the minutes all come under each other so that, by taking the sheet off of the

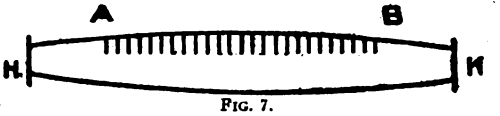


FIG. 7.

cylinder, and spreading it out, writing in the minutes and the lines of seconds, the observer can determine the exact moments at which every one of any number of signals were made while the chronograph was running. For example, in Fig. 6 it will be seen that the observer pressed the key at 12 m. 3.4 s. and again at 13 m. 2.4 s.

The Spirit Level.— Another appliance much used in astronomy is the spirit level. It serves to set the axis of an instrument exactly horizontal. It consists of a glass tube, generally six or eight inches long, of which the rounded surface is not a perfect cylinder, but is formed by the revolution of the arc of a very large circle around its chord. The tube is therefore of the shape shown in Fig. 7, slightly larger in the middle part than at the two ends. The amount of bulging is, however, so slight that the eye cannot perceive it. In the

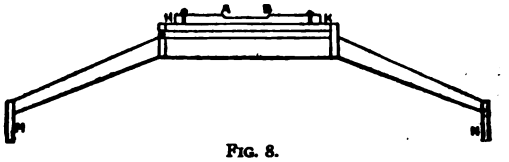


FIG. 8.

most delicate levels, a section of the curved surface is an arc of a circle perhaps half a mile, more or less, in diameter. The tube is nearly filled with chloroform or ether. Water, or even alcohol, is not liquid enough for the purpose. A small vacant bubble is left at the top of the cylinder, as shown at A B in Fig. 7. When this bubble is in the middle of the tube, the axis of the level is perfectly horizontal. The remainder of the level is sketched in Fig. 8, which shows the level completely mounted, so that it can be set on the horizontal pivots of the instrument of observation. The true horizontality of the pivots is tested by reversing the level end for end, reading the position of the bubble at each setting. Details need not be entered into at present, as we only wish to make the principle of the instrument clear. Nearly all instruments for astronomical measurement are made by putting together some combination of the devices we have described. The two combinations most used in astronomical observations are the Meridian Circle or Transit Circle, which are the same in principle, and the Equatorial Telescope.

The Meridian Circle.— This instrument is used for two distinct purposes. One is the determination of the right ascensions of the heavenly bodies; the other the determination of their declinations. It will conduce to clear-

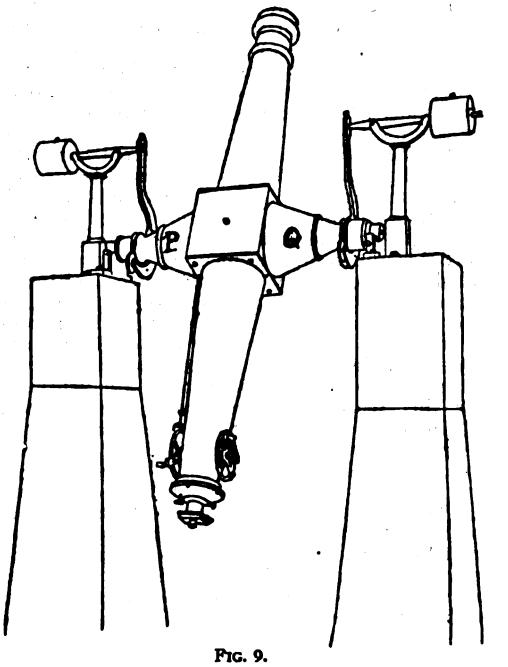


FIG. 9.

ness to consider these two functions separately and begin with the instrument as adapted to the first purpose. In this form it is called the transit instrument and is shown in Fig. 9. It consists essentially of a telescope mounted on a horizontal east and west axis P Q, the horizontality of which is tested from time to time by a spirit level. As thus mounted it will be seen that the telescope cannot move out of the meridian; by turning it on its axis, its line of sight marks out the meridian. Consequently, if an observer looking into it sees a star, or other heavenly body, he knows that the star must be near the meridian. To make the ob-

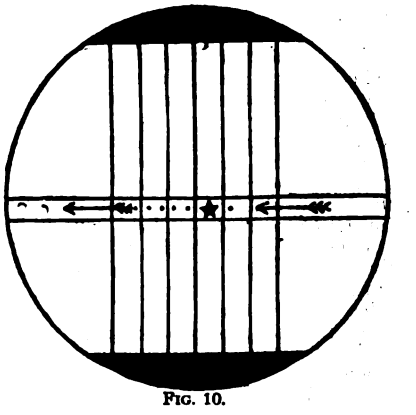
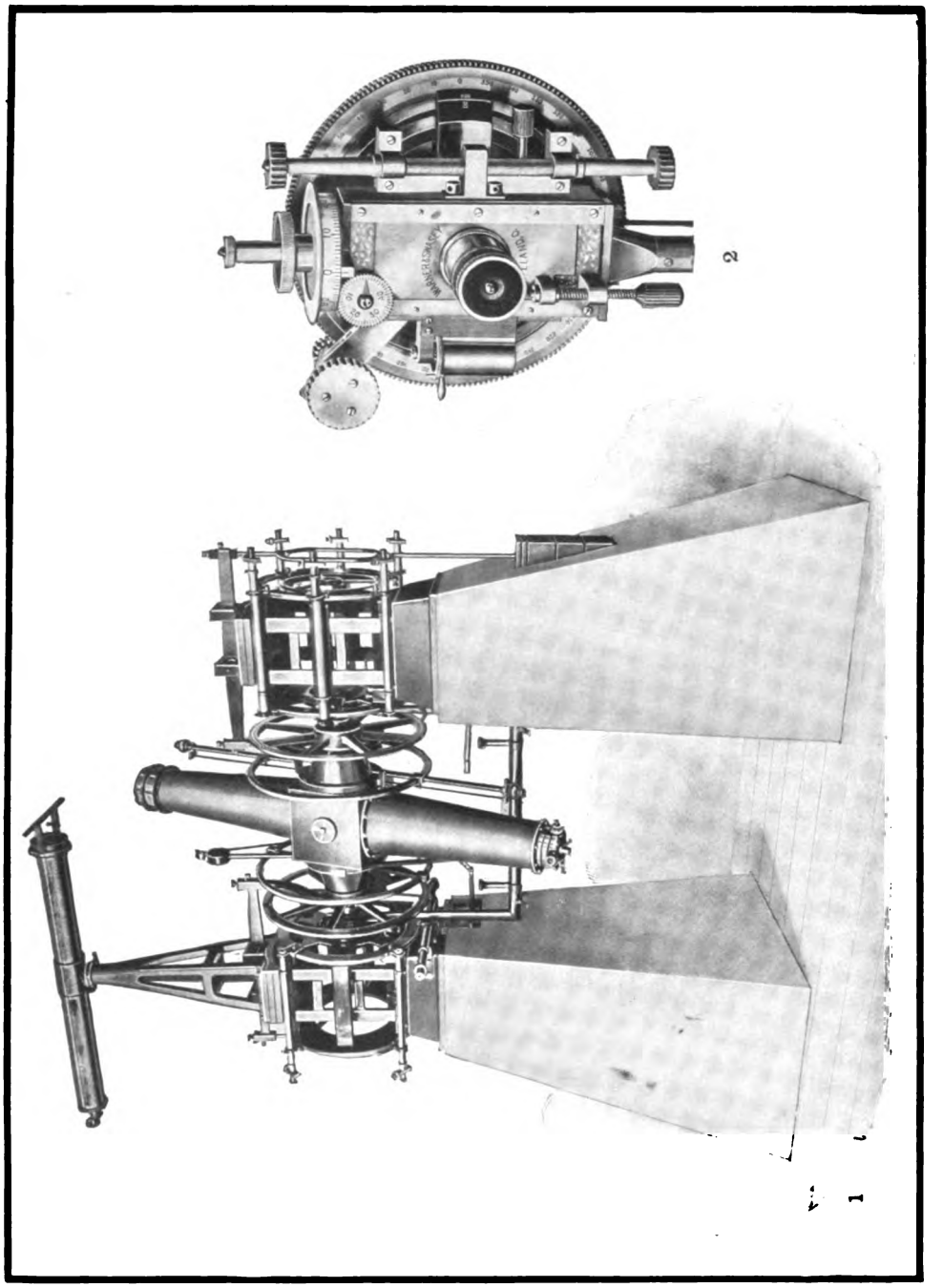


FIG. 10.

servation more exact, a system of spider lines, shown in Fig. 10, is stretched across the focal plane, as already described. The middle line is so adjusted as to mark the meridian with the



1 Six-inch steel Meridian Circle, U. S. Naval Observatory, Washington, D. C.
2 Steel Position Micrometer

greatest possible exactness. The result is that the observer, looking into the instrument, sees these spider lines, and he may also see a star moving toward the meridian by virtue of its apparent diurnal motion as shown in the figure, where it is about to cross the meridian line. Watching it with a key connected with the electric circuit of the chronograph in his hand, he taps the key at the moment the image of the star crosses each of the lines. The middle line marks the passage across the meridian. The other lines are used in order to secure greater exactness by taking the mean of all the transits across the separate lines. Thus, by pointing his instrument into any part of the meridian, the observer may determine the times by his sidereal clock at which any number of stars crossed the meridian of his place.

In order that the line of sight of the instrument may describe the true meridian, it is necessary that, when the instrument is turned in the proper direction, the line shall pass

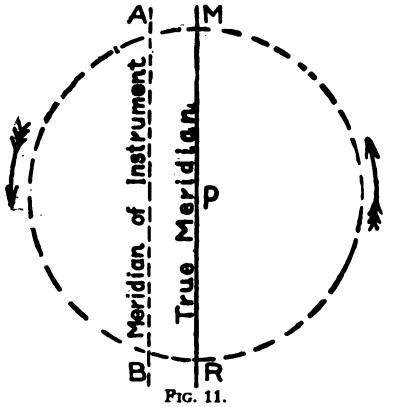


FIG. 11.

through the celestial pole. This is effected by the following arrangement: In the course of its apparent diurnal motion, a star near the pole will cross the meridian of any place twice in the course of a sidereal day, first above the pole and then below it. Let the dotted circle in Fig. 11 be its apparent diurnal circuit around the pole P. Let the vertical line M R be the true meridian passing through the pole, and the other line A B that marked out by the line of sight of the transit instrument, supposed not to be exactly in the meridian. Then the star will take a less time in passing around from A to B on the left than in the other part of its course from B to A. Therefore by observing the transit both above and below the pole, across the middle thread of the instrument, the observer determines whether the line of sight of the instrument passes east or west of the pole and may adjust it accordingly. It may be said that, in astronomical practice, no instrument is ever assumed to be perfectly adjusted. The clock of the astronomer is never assumed to be correct, nor his transit instrument to be in the true meridian. What he does is, assuming them wrong, to make his observations, determine the errors, and correct his observations accordingly. This is called "reducing" the observation. We have already explained that, when a star is exactly in the same hour circle with the vernal equinox, its right ascension is 0 h., 0 m., 0 s. Since the clock, assumed to be correct, then reads exactly 0 h., it follows that the star in question will cross the meridian at this time by the clock. Then, as the sphere revolves, the right ascensions of the stars are all equal to the sidereal time at which they cross the meridian. Thus the observer, by noting these times, measures the right ascensions of the heavenly bodies. This system of using the clock instead of a divided circle for determining right ascensions constitutes one of the greatest advances ever made in astronomical measurement. It depends upon the perfect uniformity of the earth's rotation and the excellence with which a clock can be made.

In this manner we may obtain the right ascension of any star. If we suppose that the error of the clock is known and that the middle wire is exactly in the meridian, the corrected (sidereal) clock time when the star is bisected by the middle wire will be precisely the same as the right ascension of the star. The clock error is determined by observing the transits of a selected number of fundamental stars whose right ascensions are assumed to be known; the deviations of the middle wire from the meridian are also determined from these transits, and finally, the combined effect of these errors and the error of level is readily computed and applied to the recorded time of transit of the star whose right ascension is desired.

A far more troublesome source of error, however, and one which it is exceedingly difficult to completely eliminate is known to astronomers as the *Personal Equation*. By this is meant the difference between the time when the star is actually bisected and the time at which the observer presses the chronographic key. The latter is usually later by about 0.2 second, an amount which approximates to the "Reaction time" of the psychologists, but this is by no means always the case. Moreover, as the apparent motion of equatorial stars across the field is very rapid compared with that of stars near the pole, there occurs a marked variation in the observer's personal equation, depending on the declination of the star observed. It is found that a minute variation also occurs which depends upon the brightness of the star, and finally, the personal equation varies with the physical condition, fatigue, etc., of the observer, though with an observer of long experience who takes care to work as far as is possible only under normal conditions, the last source of error should be slight.

As meridian work is the most important and fundamental of all observation for the purposes of exact astronomy, every effort is made to either determine or eliminate the effects of personal equation. In the United States Naval Observatory, it is directly determined for each observer by means of an artificial star which is made to cross the field at all varying rates of speed and automatically to record upon the chronograph the instants when it was bisected by each wire; the observer's records appear upon the same sheet, whence the personal equation follows by a direct measurement. Here also a screen is placed before the objective of the telescope by which all stars observed are made to appear equally bright during the transit. There are

two devices already coming into considerable use which almost completely eliminate this troublesome source of error. In the first, called the Transit Micrometer, a moving wire is kept accurately bisecting the star as the latter crosses the field. The frame which carries the movable wire automatically makes an electric contact and records on the chronographic sheet when this movable wire reaches the successive transverse wires indicated in Fig. 10, which latter are therefore omitted. The second device is the Photo-chronograph. Here the eye is replaced by a small photographic plate on which the star photographs itself as a straight line, or «Trail.» An electro-magnet is so arranged that at every second or fourth beat of the clock the plate is displaced slightly upward or downward; the trail thus appears on the developed plate as a series of short dashes arranged alternately in two parallel lines. The image of the wires is afterward obtained by holding a light for a few seconds in front of the object glass. By a later measurement of the developed plate under a microscope a result is obtained which is practically free from the effects of personal equation.

The Meridian Circle is the transit instrument, just described, with one or two graduated circles on its axis of rotation. The method of using it and determining the arc through which the circle has moved at any time has already been explained. The inquiring reader may wish to know how, by such readings, the astronomer can determine the declination of stars. If the celestial pole were a visible point in the heavens this would be very simple; the observer would turn his instrument until it pointed exactly at the pole and then read his microscopes. Then as one star after another crossed the meridian he would make a similar pointing, reading his microscope for the transit of each star. The difference between the reading on the pole and that on the different stars would show their distances from the pole. Subtracting each of these from 90° would give the declination of the stars as seen in the instrument.

But, unfortunately, the pole is not a visible point. The observer has therefore to refer his position to the direction of gravity, which is done by a very ingenious use of a basin of quicksilver. The basin is set on a firm support on the ground under the telescope, and the latter is pointed directly downward. By mounting up to the eye-piece and looking down, the observer looks perpendicularly into the basin of mercury. A combination of reflectors is then arranged in the eye-piece of the telescope so that he can, at the same time, see the threads in his eye-piece and the images of these threads as reflected from the basin of mercury. When a telescope is so adjusted that the image and the thread coincide, he knows that the line of sight of his telescope is truly vertical. He then reads the microscope of his circle and so determines what the reading of his circle is for the vertical position. He knows that if the telescope is pointed at the zenith, the reading will be different by exactly 180°. He thus determines the exact distance at which the heavenly bodies crossed the meridian north or south of his zenith. From this, the determination of the declination is, in principle, a simple matter.

The Equatorial.— One of the most important arrangements of nature with which the astronomer has to deal is the diurnal motion. This takes place so slowly that, in looking at the stars, we do not notice it unless we watch for some time. But, if we point a telescope at a heavenly body, it magnifies the diurnal motion as much as it does the object. The result is that such a body, seen in a fixed telescope, is continually traveling across the field of view, and the instrument has to be moved continually to keep up with it.

In order to avoid this inconvenience, it is necessary that, if measures are to be made upon the body, or if it is to be continuously studied, the telescope must move to correspond. This is brought about by mounting it upon an axis parallel to that of the earth, and therefore oblique to the horizon, called the polar axis. The inclination to the horizon must be equal to the latitude of the place. All great telescopes are thus mounted. The way in which this is done will be seen by the accompanying picture of the great telescope mounted at Pulkova, Russia. In order to keep the telescope pointed at the object it must be turned upon the polar axis by clock-work, moving it steadily at a rate equal to the diurnal motion of the object observed. In reality the telescope is then pointed in a fixed direction, the motion of the earth being simply neutralized by the clock-work of the telescope carrying the latter in the opposite direction. The equatorial telescope must also have a second axis, called the declination axis, in order that it may be pointed at stars in different declinations. The direction is determined by circles attached to the telescope, which show, at any time, to what declination on the celestial sphere the instrument is pointed. By a combination of contrivances the astronomer can point his telescope by day at any star bright enough to be visible in it; or, by night, at any object visible to the naked eye, of which he knows the right ascension and declination. He first turns his telescope until one divided circle corresponds to the declination of the star, and then clamps it in that position. Then, looking at his sidereal clock and taking the difference between the sidereal time and the right ascension of the star, he turns his telescope on the polar axis until the other circle shows the correct pointing. Then he starts the clock-work which sets the telescope in motion, and looking into the eye-piece, sees the required object. Every large telescope is also supplied with a finder. This consists of a smaller telescope fastened to the larger one in such a way that the centre of the field of view is the same in both. But the finder has a lower magnifying power, and therefore a much larger field. Looking into it and recognizing the object he wishes to observe, the observer moves the telescope until the object is seen on the cross-threads of the finder. Then he knows that it is in the field of view of the large telescope.

Application of Photography to Astronomy.— From the time that photographic methods were introduced, the idea of taking pictures of the heavenly bodies by such methods must have occurred to astronomers.

About the year 1840, Prof. J. W. Draper of New York put this method into practice by taking a daguerreotype of the moon. Shortly after our present system of photography was devised, several American astronomers carried the experiment yet farther. Notable among these were G. P. Bond, first assistant and afterward director of the Harvard Observatory; and L. M. Rutherford of New York, who was the possessor of an excellent telescope, and brought the method to a high state of perfection.

The principle on which a photograph of a heavenly body is taken is extremely simple. A telescope is pointed at the body so that the image of the latter is formed in its focus. A sensitized plate is placed in the focus and exposed for the necessary time. This may be only a fraction of a second, or it may be several hours. Unless the exposure is very brief, it is necessary that the telescope shall be kept in motion, so as to follow the object in its apparent diurnal course. When the exposure is completed, the image is developed in the usual way. In photographing, the ordinary telescope, as used for eye observations, is not well suited to the purpose, for the reason that

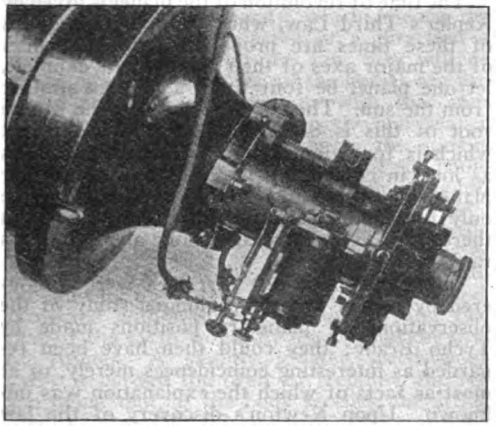


FIG. 12 — The Photochronograph

the chromatic aberration is not the same for the visual and for the photographic rays. It is necessary to have a somewhat stronger crown lens or a weaker flint lens if a telescope is to be used in photographing than if it is to be used by the eye. But the necessity of having telescopes of the two kinds is now, to a certain extent, done away with by the use of sensitized plates which are especially sensitive to the visual rays. By putting in an absorbing screen through which the rays must pass before they reach the focus and which allows only the visual rays to pass, very accurate photographs can be taken by the plates. This defect is felt only in the refracting telescope. A reflecting telescope brings all the rays, of whatever color, to one and the same focus, and therefore may be used either for photographing or for seeing. Improvements made in recent times in the sensitiveness of photographic plates have given an enormous extension to this method in astronomy. It is now found that celestial objects completely invisible to ordinary vision can be photographed. While only a few thousand nebulæ have been catalogued as visible to the naked eye, it is found that there are hundreds of thousands which admit of being determined by photography.

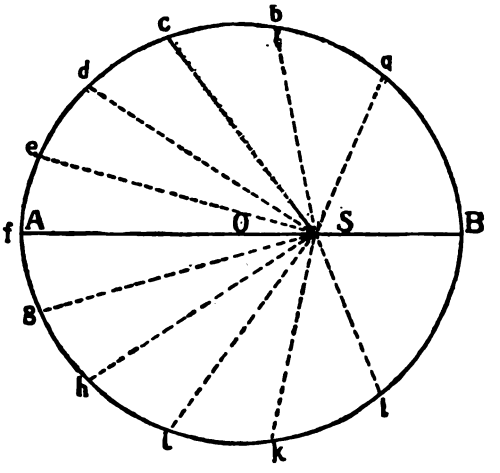
Photography is now employed for two distinct purposes. The first is simply that of forming a picture of the sky, or rather of the stars in the sky. For this purpose the best telescope is one as large as can conveniently be obtained, but of short focal length. A great enterprise in this direction was started in 1887 by an association of astronomers who met at the Paris Observatory, and put into operation a plan of photographing the entire heavens on from 10,000 to 20,000 plates, each two degrees square. The labor of measuring these plates and of afterward reducing the measures from them is so great that at least 30 years will probably elapse before this catalogue is completed and published. A similar object is reached on a different system at the Harvard Observatory. There photographs are being constantly taken with telescopes much shorter than those used for the international chart. In this way new stars are from time to time discovered and variations in the light of different stars are brought out. The other purpose is that of exact measurement. When the astronomer had to determine the respective distances of stars in the same field of view he has hitherto generally depended on the filar or other micrometer. The use of this instrument is laborious. When the photographic method is used he simply takes a picture of the stars he wishes to measure, and at any convenient time, places it under a measuring engine supplied with sliding microscopes, and measures off the distance on his negative. The result of these two applications is that photography is now slowly supplanting eye observations in an important fraction of the astronomical work of the world.

SIMON NEWCOMB.

Revised by ERIC DOOLITTLE, *Professor of Astronomy and Director Flower Astronomical Observatory.*

ASTRONOMY, Theoretical. This branch of the science grows out of the great discovery of Newton, that the motions of the heavenly bodies, especially those of the solar system, are determined by their mutual gravitation. The results of this theory are now worked out by purely mathematical methods with a degree of precision scarcely attainable in any other branch of science. The adopted method consists first in expressing the attraction or pull experienced by each body from all the others in the form of differential equations. These equations express, in the most general way, the acceleration which the planets experience at every moment from the attraction of the other bodies. We do not write them because they would be understood only by a reader expert in the calculus, who, if he desires to be acquainted with them, will consult special treatises. It will suffice to say that there are three differential equations for each planet, which express the attraction, and its effect on the motion of the planet at any instant, in the direction of three co-ordinates. The problem then becomes the purely algebraic one of integrating these equations. The result of this process is that the effect of the

attraction or pull upon the body, through a period of days, years or even centuries, is summed up with great exactness, so that the motion of the body through the whole period can be expressed by algebraic equations. The simplest case occurs when there are only two bodies. The integration shows that, in this case, the bodies revolve round their common centre of gravity in orbits each of which is an ellipse. Commonly it is necessary to consider only the motion of the smaller of the two bodies, the motion being defined as if the larger were at rest. This is the case of a planet revolving around the sun, or of a satellite round its primary. It is then found that the orbit described by the revolving body round the great central body is an ellipse having the latter in one of its foci. The discovery of this fact, which marked an epoch in the development of astronomy, was due to Kepler; it is known as Kepler's First Law. Kepler also discovered that the motion is subject to two other laws. One of these is that the radius vector, that is to say, the line drawn from the central body to the other, sweeps over equal areas in equal times. The result of this is that if A B be the orbit having the sun, S,



in the focus; and if we mark on the orbit the points *a, b, c,* etc., which the planet passes through at any equal intervals of time, and then draw lines from each of these points to the sun, the areas included between these lines will all be equal to each other. A glance is sufficient to show that the nearer the body is to the sun the more rapidly it must move.

The position of the orbit and the place of the body in it are determined by six quantities called *elements*. Two of these elements express the position of the plane in which the ellipse lies, and therefore in which the planet moves. One is the inclination of the plane of the orbit to some other plane taken as that of reference. For the latter is commonly adopted the plane of the ecliptic, in which the earth revolves round the sun. When the inclination of the orbit of any other planet is spoken of, the astronomer means the angle which the plane of its orbit makes with the plane of the ecliptic. The other of the two elements expresses the line passing through the sun along which the two planes intersect. This is called the Line of Nodes. The position of the node is defined by the angle, as seen from the sun, between the vernal equinox and that node where the planet crosses from the south to the north side of the ecliptic. Three other elements determine the size and form of the elliptic orbit, and its position in its plane. The semi-major axis, A B, of the ellipse is called the mean distance of the planet from the sun, it being half the sum of the greatest and least distances. The other of these elements is the eccentricity of the orbit, which is equal to the quotient obtained by dividing the distance of the sun, O S, from the centre of the orbit by O A, the semi-major axis. These two elements completely determine the ellipse. The exact position of the ellipse in the plane may then be defined by the angle which the semi-major axis, O B, makes with the line of the nodes. It will be seen that the point B is that at which the planet is nearest to the sun. This is called the perihelion of the orbit if the central body is the sun; if the earth is the centre, the perigee. The opposite point, A, where the planet is most distant, is called the aphelion, or apogee. Finally, the sixth element defines the position of the planet at some given moment of time.

The time of revolution of the planet is given by Kepler's Third Law, which is that the squares of these times are proportional to the cubes of the major axes of their orbits. For example, let one planet be four times as far as another from the sun. The cube of 4 is 64. The square root of this is 8. It follows that the planet which is four times as far will be eight times as long in completing its circuit. If the outer planet went as rapidly as the other, it would be only four times as long. Its orbital motion is therefore, on the average, only about half as rapid.

The three laws just described were discovered by Kepler from a prolonged study of the observations of planetary positions made by Tycho Brahe; they could then have been regarded as interesting coincidences merely, or at most as facts of which the explanation was unknown. Upon Newton's discovery of the law of universal gravitation, however, they were at once seen to be immediate and very simple consequences of this law, but it then appeared that the third law in the form stated by Kepler was slightly inexact. For it could be easily demonstrated that it was not the squares of the times of revolution which are proportional to the cubes of the major axes of the orbits, but that the products of the squares of these times multiplied by the sum of the masses of the central and of the revolving body are proportional to these quantities. This is sometimes called Kepler's Modified Third Law. It furnishes us with a very simple means of finding with a high accuracy the masses of such planets as have satellites revolving around them. The introduction of the masses into Kepler's third law alters the results by quantities far too small to have been detected in the observations studied by him; thus, it can be shown that were the earth suddenly to diminish to a mere particle, devoid of weight, the length of the year would be increased by only 47.8 seconds.

In theoretical astronomy a unit of distance is necessary. Our ordinary units do not well serve the purpose of the astronomer for two

reasons. They are too short for the great distances he has to measure, and the magnitude of the heavens in terms of miles is not known with sufficient exactness to make that measure convenient. What the astronomer does, therefore, is to take the mean distance of the earth from the sun as his yardstick, and to express the distance of all the bodies of the solar system, both from the earth and from each other, the moon sometimes excepted, in terms of this unit.

From the laws of motion based on gravitation may be derived several interesting theorems. For example, suppose that at some point in the solar system,—we may take, to fix the ideas, a point at the mean distance of the earth from the sun,—a number of bodies are projected in different directions, but all with the same velocity. Then, the equations of motion show that the major axes of the orbits which these bodies describe will all be equal. Then, from Kepler's third law it follows that the times of revolution will also be equal. Consequently, at the end of a certain period the bodies will all return at the same moment to the point from which they started. This period will depend only on the velocity with which the body is projected. There is a certain velocity, called the circular velocity, which is such that if the bodies are projected in a direction at right angles to that of the sun, they will describe circular orbits. If all the bodies are projected at different directions with this same velocity, they will all be exactly one year in getting around and returning to the starting point. Now suppose that, instead of the bodies being projected with this circular velocity, which is very nearly that of the earth in its orbit, they are projected with a somewhat smaller velocity. Then, the less the velocity the less the major axis of the orbit, and the greater the velocity the greater the major axis. A body projected with a speed one-third greater than that of the earth would fly out beyond the orbit of Jupiter. A slightly greater speed would carry it beyond the orbit of Neptune, the reason being that, as the body recedes, the attraction of the sun diminishes at so rapid a rate that the weak attraction left is not sufficient to overcome the slight surplus velocity. Finally, if the speed is equal to that of the earth multiplied by the square root of two, that is to say, about 26 miles per second, the body will never return. The ellipse in which it should move is stretched out into a parabola, still having the sun in its focus. If the velocity is greater than this, the parabola will be still farther changed into a hyperbola. Then the body would fly out into the stellar spaces, perhaps in the course of millions of years reaching some other sun, but would certainly never return to our system. Another theorem is that the velocity, no matter what the form of the orbit, diminishes as we go out from the sun in proportion to the square root of the distance. This we have already seen by Kepler's third law, when we found from that law that a planet four times as far from the sun would move only half as fast. Thus the parabolic velocity is less the farther a body is from the sun. At the planet Uranus it is less than six miles per second; at that of Neptune, about five miles per second. Still another theorem is that if a planet moving in a circular orbit were stopped at any point of its motion, and then were allowed to drop toward the sun, the time of reaching the sun would be equal to that of revolution divided by the square root of 32. It follows that if the earth should be stopped in its motion, it would drop to the sun in a number of days found by dividing 365.24 by the square root of 32. This would be approximately 64 days.

The orbits of most of the large planets are nearly circular. For particulars relating to them see SOLAR SYSTEM. The orbits of comets are, however, mostly parabolas, or ellipses which cannot be distinguished from parabolas when the comet is near enough the sun to be visible. It is possible that some of those orbits which are ellipses have become so through the comet at some time in its history passing very near a planet. (See COMET). One of the problems of theoretical astronomy which the astronomer often meets with is that of determining the orbit of a newly-discovered body of the solar system. Three complete observations of such a body, that is to say, three observations each of which determines exactly the apparent position of the body on the celestial sphere, enable the astronomer to determine the orbit in which it is moving round the sun. The calculation requires from five to ten hours' work by an expert calculator having at his command the necessary tables. The first orbit thus computed may be considerably in error, because the effect of errors of observation is multiplied many fold, unless the planet has moved through a considerable arc of its orbit between the times of observation. But the longer the planet is observed, the more exactly the elements of its orbit can be determined. It is found that when two stars are so near each other as to be kept together by their mutual attraction, they revolve around each other in an elliptic orbit. It follows that the law of gravitation extends to these systems. Thus the calculations of the theoretical astronomer are not confined to the solar system, but may be extended to the fixed stars.

In all that precedes we have considered only the motion of two bodies, the smaller of which moves around the larger in an elliptic orbit. But, as a matter of fact, every planet of the solar system is acted upon not only by the great central body, but by every one of the other planets. The result is that the actual orbit, although very nearly an ellipse, deviates slightly from it, and the motion is not exactly in accordance with Kepler's laws. The problem of taking account of these additional forces is an extremely complicated one, in which success has been reached only by successive generations of the ablest mathematicians devoting long years of study and calculation to the subject. While the solution, even to-day, is far from complete, it has been so far advanced that it is possible to prepare tables of the motions of the planets which shall hold good for generations, and even for centuries. The method in which the problem can best be solved was devised by Lagrange, who flourished in France toward the latter part of the 18th century. The fundamental idea of his method was that the motion of the planet at every instant should be represented by an ellipse, but this ellipse continually changes its form and dimensions so as to fit in with the actual motion of the planet under the influence of the attraction of all the

other planets. Some idea of the case may be imagined by supposing a cord of some light material made into an ellipse very nearly a circle, and left to float on the waves of the ocean. Then we should see the cord, while still remaining almost in its original shape, continually bending and twisting as it was moved by the waves. So does the variable ellipse in which the planet moves. It is exactly defined by supposing that, at any one instant, the attraction of all the other bodies, the sun excepted, ceases. Then the planet would move in a fixed and unchangeable ellipse. This ellipse is taken as that which corresponds with the motion of the planet at the instant. At a second instant the planet would actually have deviated slightly in consequence of the attraction of the other planets, but there would still be a corresponding ellipse, but somewhat different. So the ellipse goes on changing continually.

When these changes are subjected to the rigor of mathematical formula, it is found that they nearly, but not quite, compensate each other in the long run. Let us take, for example, the eccentricity of any one orbit. This will vary in the course of every revolution of the planet, and may come back to its original amount any number of times. But, if we watch it revolution after revolution, we shall find that, in the long run, it continually increases or diminishes. It is thus found that the eccentricity of the earth's orbit has been diminishing through all historic times. Moreover, the general rule is that the perihelion of the planet is gradually moving forward, and the line of nodes backward. These variations, which go on century after century, are called secular variations, while those which are compensated from time to time are called periodic. Now, the most interesting and important question of celestial mechanics is whether the secular variations will continue forever in the same direction. The profound analysis of Laplace and Lagrange shows that such will not be the case so far as the eccentricities are concerned. At the end of immense periods the direction will be reversed. It is now known that the eccentricity of the earth's orbit after diminishing to about the value 0.003 will increase for a certain period. It is thus with all the orbits; the motions go through a series of oscillations having periods of hundreds of thousands of years — like "great clocks of eternity which beat ages as ours beat seconds." The precision with which the astronomer is now able to predict the motions of the heavenly bodies is reached by a combination of mathematical computations of the most difficult and complicated character, with the most refined observations upon the positions of the moon and planets, year after year.

The most complex of all the problems is that of the moon's motion around the earth, of which we shall mention some features. In this case the central body, the earth, is vastly smaller than the sun. But, owing to the great distance from the sun and the consequent small difference in the force of its attraction upon the earth and moon, it happens that the moon revolves around the earth in an orbit which approximates to an ellipse. But the changes and motions in this ellipse are much larger and more rapid than in the case of the planets. For example, the perigee of the moon's orbit makes a revolution round the earth in 8.85 years, while the node on the ecliptic makes a revolution in 18.6 years. The moon also makes two swings back and forth during the space between two full moons, and the eccentricity and perigee both make an annual swing, all owing to the action of the sun. See MOON.

The principles of theoretical astronomy and the operations of practical astronomy are combined in one of the greatest achievements of the human intellect — that of measuring the heavens and weighing the planets, and, in a few cases, even the fixed stars.

The distance of the moon is determined in two ways, the results of which agree within the necessary range of uncertainty of the methods. One is the measurement of the moon's parallax, taking as the base line two distant observatories, Greenwich and the Cape of Good Hope. (See PARALLAX). The other method consists in determining exactly what ought to be the size of the moon's orbit in order that she may make her revolution around the earth in the time that she actually does. The probable error of the distance of the moon at any time, as determined in this way, is not more than 40 or 50 miles.

The proportions between the orbits of the several planets are known with the greatest exactness from their observed times of revolution, and from Kepler's third law. It follows that if we can get the exact distance of any one planet at any one time, all the other distances in the solar system may be derived by the known proportion. The fundamental quantity which is used as a unit of measure is the distance of the sun. This distance has been determined by four complete separate and independent methods, the agreement between which illustrates the great exactness of astronomical theory.

The first method is by measures of parallax. The application of this method is fully described in the article PARALLAX. It requires that the apparent direction of a planet among the stars be observed with great exactness from two far distant points of the earth's surface, or at two times of day during the interval between which the observer is carried around by the rotation of the earth. These observations have to be on a planet and not on the sun, because the latter, owing to the brilliancy of its light, cannot be measured with the necessary precision. The most celebrated way of determining parallax has been by observing transits of Venus (q.v.). But these occur at such rare intervals, the last having been in 1882, and there being no other to occur during the 20th century, that the measures have to be made on other planets which approach nearest to the earth. For this purpose Mars has sometimes been used, because it occasionally approaches us within less than half the distance of the sun. But the most exact observations can be made on minor planets at the time of their nearest approach; the minor planet Eros thus furnishes a more accurate value than can be obtained in any other way.

The second method is by the velocity of light. This method is, in principle, the most simple and elegant of all. It rests on the fact that it is possible, by two kinds of observation, to determine how long it takes light to pass from the sun to the earth, or to cross the

earth's orbit. If then we can determine by measures of the earth's surface how fast light travels, it follows that by multiplying this velocity by the time it takes to travel from the earth to the sun, we shall have the distance of the sun. The velocity of light has actually been determined with great precision by means of the revolving mirror. (See LIGHT, VELOCITY OF). The result is a speed of 186,330 miles per second. The time required for light to cross the earth's orbit is much more difficult to determine. The only way in which a direct determination can be made is through observations of the eclipses of Jupiter's first satellite. By comparing the times of these eclipses through a long series of years when Jupiter is at various distances from the earth, it is found that the eclipses are seen later, the farther Jupiter is from the earth at the time. This is because light requires time to travel over the different distances. But the determinations made in this way are not very exact, because such eclipses take place so gradually that it is impossible to fix upon a precise phase without a possible error of several seconds. All we can say as a result of this method is that it takes about 8 m. 20 s. for light to pass from the sun to the earth.

A more exact result is reached by measuring the displacement of the fixed stars produced by aberration. As the earth makes its annual course around the sun, the position of every star in the heavens is, at every moment, slightly displaced toward the direction in which the earth is, at the moment, moving. This is due to the proportion between the velocity of light and the speed of the earth in its orbit. Unfortunately, the speed is so great that the displacement in question is only about 20.5″; an arc too small to be determined with the precision that is desirable. Still, the observations available are so numerous that the result, 20.52″, found by Chandler, is probably within one, or, at most, two hundredths of a second of the truth. Accepting Chandler's number, light requires 499.67 seconds to pass over the distance which separates the sun from the earth. Multiplying this by the speed of light, we have, 186,330×499.67=93,103,511 miles as the distance of the sun.

The third method is a very recondite one, because it rests on the mathematical principles of celestial mechanics, applied to the case of the earth's motion around the sun. It requires, in advance, an exact determination of the ratio of the mass of the sun to that of the earth. This is best found by observations of Venus, which now extend through more than a century and a half, by which the motion of the node of Venus on the ecliptic is determined. This motion is due principally to the attraction of the earth; and from it the proportion between the mass of the earth, and that of the sun is determined. The next step requires a comparison between the distance which a body falls at the surface of the earth from its own gravitation, and the fall of the earth toward the sun as shown by the curvature of its orbit. By combining these various ratios, the distance of the sun is calculated. The fourth method also rests on the theory of gravitation. One consequence of the sun's action on the moon is that the latter falls behind about two minutes in its monthly course near the time of the first quarter, and is ahead by the same amount near the last quarter. Knowing the exact amount of this swing, the distance at which the sun must be placed in order to produce it is determined. Each of these four methods has its strong and its weak points; and there is no one of them so much better than all the others that we can rely upon it exclusively. Still, their agreement affords a remarkable proof of the accuracy of astronomical theory, and of the precision with which astronomical measures are made under such difficulties as the observer and computer have to encounter. The astronomer does not use the distance of the sun in his computations, because, as already remarked, this is simply his unit of length. What he actually uses is the sun's parallax; this is equal to the angle which the equatorial radius of the earth subtends when seen at a distance equal to that of the sun. The latest results for this parallax from the four methods are the following:

First method, from Eros, 8.806″
Second method, light, 8.78″
Third method, mass earth, 8.762″
Fourth method, moon, 8.773″

The general conclusion which we reach is that the distance of the sun is very nearly 93,000,000 miles, probably a little less, rather than a little more.

What may seem a yet more wonderful result of celestial measurement is the weighing of the planets and other heavenly bodies. This requires very complex mathematics. But, after all, the principles on which the method rests can readily be made clear. In the case of the planets, there are two methods, one of which can be applied only when a planet has a satellite moving around it. We have already seen that the motion of every planet which, were there no other planet, would take place in an ellipse having the sun in a focus, is changed by the attraction of other planets. The observation of the deviations, when carefully measured through many revolutions of a planet, enable the mathematical astronomer to compute the ratio of the mass of each attracting planet to that of the sun. This ratio is all that the astronomer requires for his ordinary work.

When the planet has a satellite, its mass can be determined with much more ease and simplicity by a direct application of the modification of Kepler's third law. The measurements of the distance of the satellite from the planet, carried through a great number of revolutions of the former, enable the astronomer to determine this distance with high accuracy; combining this with the time of revolution of the satellite and substituting the values in the equation which expresses the law, it will be noticed that two unknown quantities appear in the equation. The first of these is the desired sum of the masses of the planet and its satellite, and the second is the constant expressing the ratio of the law. The figure expressing the latter can be found by applying the equation to any system all of whose elements are known, such, for example, as the earth-sun system; when this is done, the sum of the masses of the planet and its satellite remains as the only unknown quantity; the solution of the equation will thus furnish this sum in terms of the sum of the masses of the earth and sun as a unit.

It is in exactly the same way that the com-

bined mass of two suns forming a double-star system is determined. The distance of the system from the earth must be known and the motion must have been sufficiently rapid to enable the period and the major axis of the relative orbit to have been determined. The law then gives us directly the total mass compared with that of the earth and sun. In this case the two bodies are frequently of nearly equal mass and the motion of each takes place about the common centre of gravity of the system. If we determine the actual motion of each star by measuring its positions with reference to one or more fixed stars which happen to be found in the field of view, the position of the centre of gravity, and hence the comparative masses of the two stars of the system, can readily be found. From this the actual weight of each star separately at once follows. The masses determined by astronomical methods are all expressed by taking the mass of the sun as the unit. To translate the result into our ordinary measures of weight, we must know the mass of some one body, say the earth, in pounds or kilograms. How this is found is set forth in the article GRAVITATION.

SIMON NEWCOMB.

Revised by ERIC DOOLITTLE, *Professor of Astronomy and Director Flower Astronomical Observatory.*

ASTROPALIA, an island of the Sporades, the modern name for the ancient Greek Astypalæa. It is high and rugged and almost the shape of a dumbbell, its centre being a narrow isthmus connecting the larger ends. It has an area of about 80 square miles and several good harbors for small craft. Pop. about 2,000.

ASTROPHEL, the nom-de-plume of Sir Philip Sidney in writing the famous sonnets to «Stella» (1591). They are considered his masterpiece. Spenser so entitled an elegy which he wrote to Sidney.

ASTROPHOTOGRAPHY. The use of photographic methods in astronomical observations has very greatly increased both the effective power of astronomical telescopes and also the accuracy of astronomical measurements.

By exposing a photographic plate to the light of a heavenly body, at the focus of a suitable telescope or camera, and giving the requisite motion to the telescope to compensate for the apparent motion of the heavenly body, we are able to secure an autographic record of the form and details of that body, and also of its apparent position with reference to the surrounding stars. In the case of celestial objects such as the nebulæ and the more distant stars, whose light is in most cases so faint that they cannot be properly studied or measured by visual observations even with the greatest telescopes, long exposures of the photographic plate enable us to secure strong and distinct photographic records which can be studied and measured with ease and certainty. Furthermore, the more recent photographs show countless stars and countless details of nebulæ which are so faint that no trace of them can be detected visually with any telescope.

Photographic methods have been applied to solar and stellar spectroscopy with results fully as important and remarkable as in the case of the direct photography of stars and nebulæ. These methods are described in separate articles.

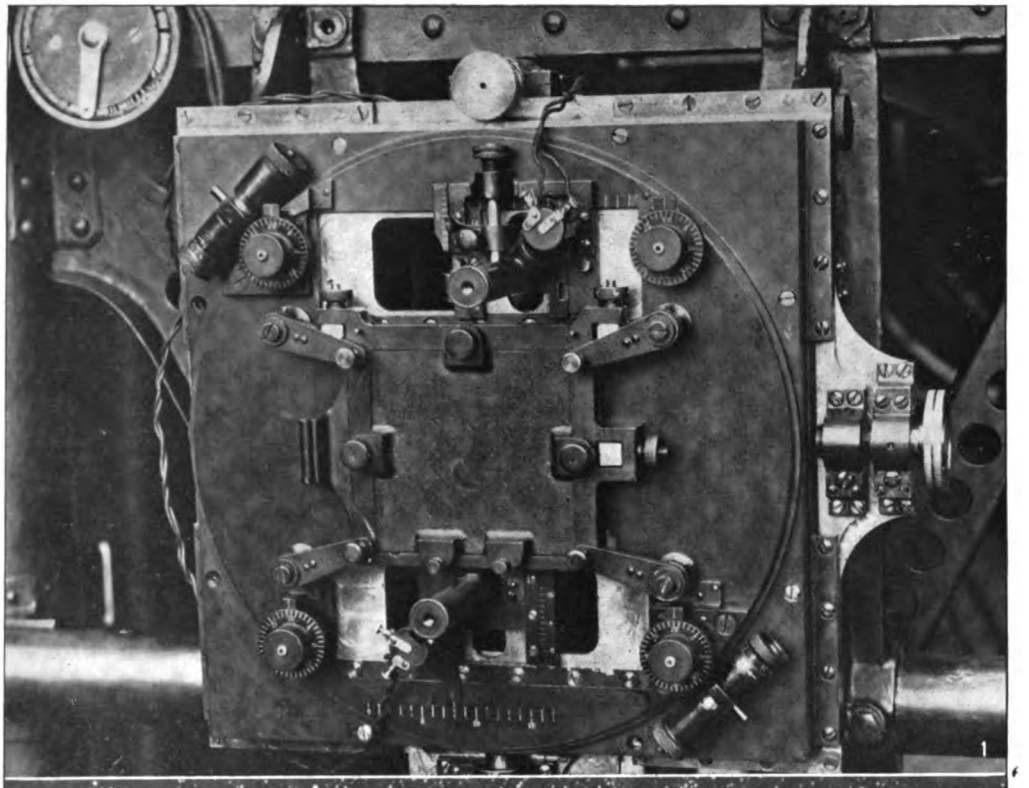
The present paper describes briefly the methods and instruments used in photographing the Milky Way or galaxy, star-fields, star clusters, nebulæ, planets, comets and the moon. These methods will be described under the heads (1) astrophotography with refracting telescopes; (2) astrophotography with reflecting telescopes.

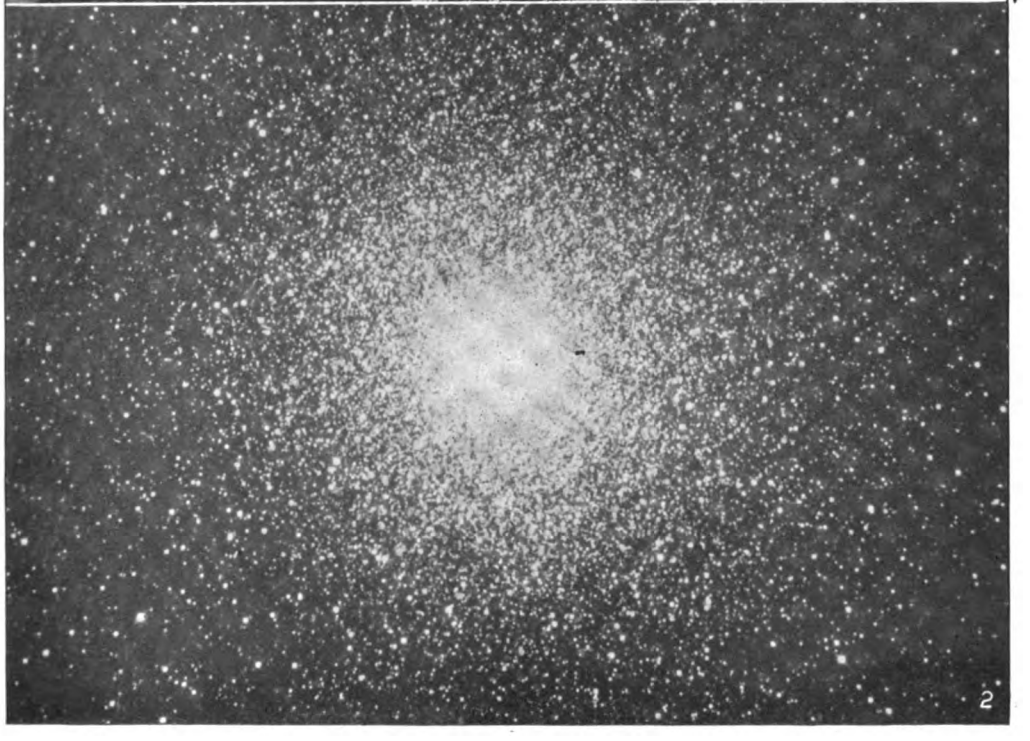
The telescope is used as a great camera. The large lens, or in the case of a reflecting telescope the speculum, of the telescope serves as the lens of the camera; the tube of the telescope serves as the camera body or box; the photographic plate is placed at the focus of the lens or speculum. The telescope is moved slowly by a powerful machine called the driving-clock, so that it continually points accurately at the apparently moving celestial body. In addition, a guiding or pointing telescope is usually attached rigidly to the tube of the photographic telescope, to enable the astronomer to watch throughout the exposure of the photographic plate, and to introduce minute corrections of motion or position, when he sees that such corrections are necessary.

Astrophotography with Refracting Telescopes.— Among the earliest celestial photographs of great value secured with refracting telescopes were those made by Barnard, Russell, Wolf and others, using the type of refractor known as the portrait-lens or photographic doublet. This type of instrument possesses the advantage that it includes a large area of the sky in one photograph, with considerable sharpness of detail all over; the best instruments of this class give a usable field of 10 or 12 degrees of arc in diameter, whereas the usual type of photographic refractor gives a usable field only one or two degrees in diameter. The astronomical photographic doublet is usually made of relatively small focal length, the ratio of focal length to aperture being 4½ or 5 to 1; this of course results in a relatively low magnifying power. In fact the great usefulness of this type of instrument is due primarily to the large area of sky which it includes; and sharpness of detail is to some extent sacrificed in order to cover a very large field.

Using this type of instrument Barnard, Wolf, the astronomers of Harvard University Observatory, Franklin-Adams and others have been eminently successful. Barnard, using first the six-inch Willard doublet of the Lick Observatory, and later the 10-inch Bruce doublet of the Yerkes Observatory, has photographed the great star-clouds and the remarkable dark rifts of the Milky Way, the great areas of extended faint nebulosity and comets. Wolf at Heidelberg, using a pair of 16-inch photographic doublets, has made a study of all of the known large nebulæ and nebulous regions of the northern heavens. The Harvard University astronomers have covered the entire northern heavens again and again with similar instruments of moderate power at Cambridge, and have also established an extremely powerful 24-inch telescope of this type at Arequipa, Peru, with which they have photographed the Milky Way, the Magellanic Clouds, the star-clusters and the nebulæ of the southern celestial hemisphere. Franklin-Adams, using a 10-inch

ASTRO-PHOTOGRAPHY





1 The double-slide plate-carrier of the 60-inch reflector, Mt. Wilson Observatory
2 Globular star-cluster Messier, 13 in constellation of Hercules

instrument, and working in England and in southern Africa, has included the entire northern and southern celestial hemispheres in his series of photographs.

In the hands of Barnard and others the portrait-lens type of refractor has been of great service in the photography of comets, with their extended tails. This type of instrument has been successfully used also in the discovery of faint comets and asteroids, by means of the slight movement of the comet or asteroid among the surrounding stars, in an exposure of several hours' duration.

An entirely different type of photographic refractor is that which was first used by Rutherford of New York, a great pioneer in this work. About 1870 Rutherford took a fine achromatic visual objective of 12 inches aperture and 15 feet focal length, and deliberately modified the surfaces of the glasses composing this objective, in such a way as to convert the visual objective into a photographic one. With this telescope Rutherford made a series of fine photographs of the moon and the coarser star clusters. About 15 years later the Henry brothers of the Paris Observatory constructed first an eight-inch, then a 13-inch photographic telescope of a type which proved so successful that it was adopted at the Paris conference of astronomers in 1887 for use in making the International photographic map of the heavens. Observatories of many nations have co-operated in this great work, the telescopes used being of uniform size and power. Each telescope has both a photographic and a visual lens or objective, the two objectives being mounted side by side in a double tube. The visual lens enables the astronomer to watch and to introduce the necessary minute corrections in the motion of the telescope while the photograph is being taken with the other lens. The photographic lens or objective does not give a sharp visual image or focus, but does unite in sharp focus all of the rays of light of the blue region of the spectrum, which rays are the ones which are chiefly effective in photography. Similarly the visual lens or objective would not give a sharp photograph, unless special precautions were taken, as described later in this article, but it does unite in one sharp focus all of the rays of light in the yellow region of the spectrum, which rays chiefly affect the human eye. The type of photographic refractor now being described gives sharply defined photographs covering an area of the sky about two degrees in diameter; and by its use the work of charting the stars of the entire heavens down to stars of the 13th magnitude has progressed with much success.

The marked success of the type of photographic refractor just described has led to the construction of several telescopes of much greater size but of similar type; i.e., with both photographic and visual objectives. Two of these great instruments, one at Meudon, France, and one at Potsdam, Prussia, are probably the largest and finest refractors in Europe. They have been used largely in spectroscopic work, and also for direct photography of star-clusters, planetary nebulæ, etc.

In the United States, methods very different from the above have been used for adapting for photographic purposes the very large visual refractors of the Lick, Yerkes and other observatories. The 36-inch Lick refractor is provided with an additional single lens, 33 inches in diameter, called the photographic corrector, which can be attached to the cell directly in front of the two lenses comprising the visual objective. The resulting combination of three lenses gives a sharp blue or photographic image or focus. This combination was utilized by Burnham, Colton and others in making a very fine series of photographs of the moon. A lunar atlas comprising these photographs was published by the Lick Observatory.

At the Yerkes Observatory a much simpler and more economical method is used for adapting the 40-inch visual refractor to photographic purposes. A yellow color-screen or ray-filter is used at the focal plane in contact with a very sensitive "isochromatic" or yellow-sensitive photographic plate. The ray-filter excludes the out-of-focus blue image (which otherwise would destroy the sharpness of the photograph) and allows the sharp and intense yellow image given by the visual objective to pass through and act upon the yellow-sensitive plate. By this means Ritchey secured a series of very sharp photographs of lunar details, and with the addition of a double-slide plate-carrier for guiding during long exposures, the same observer secured a series of large-scale photographs of the dense globular star-clusters. With the same telescope and with similar methods Barnard secured very fine photographs of the brighter planetary nebulæ and of the planets. The use in this way of the yellow ray-filter and yellow-sensitive plates has made all visual refractors available for photographic purposes. In fact several of the largest visual refractors in the world are now being used, by this means, in securing photographs for measurements of the very greatest refinement and accuracy, including measurements for stellar parallax.

Astrophotography with Reflecting Telescopes.— For photographic purposes the reflecting telescope possesses several most important advantages over the refractor. First of these is its perfect achromatism; that is, in the reflector all colors or wave-lengths of light are brought to a focus in one and the same focal plane. A second advantage is that, in the case of the very large telescopes necessary in modern astrophotography, discs of glass of a quality suitable for reflectors can be secured much more easily and cheaply than those required for refractors; in practice this means that reflecting telescopes can be made of very much greater size and power than is possible in the case of refractors. A third advantage of the reflector is that a single instrument can be so designed and constructed that it can be quickly adapted to various focal lengths, and it is therefore readily available for the photography of celestial objects requiring either low, intermediate or high magnifying powers. A fourth great practical advantage is that the reflector is relatively a short and compact form of telescope; this ensures comparative freedom from flexures which would affect the accuracy of the resulting photographs; and it greatly reduces the size and cost of the protecting dome and building.

About 1863, De La Rue in England and Draper in America first used reflecting telescopes for celestial photography, chiefly of the

moon; De La Rue using a 13-inch telescope with speculum-metal mirror and Draper a 16-inch with silvered glass mirror. About 1886 Common in England, using a 37-inch reflecting telescope with mirror by Calver, made the finest photographs of the larger and brighter nebulæ made up to that time. Common's success was so encouraging that he later constructed a 60-inch reflector, with which he secured many exquisite photographs of nebulæ. A marked contribution made to astrophotography at this time was the invention by Common of the double-slide plate-carrier in its simple form, for guiding during long exposures. In 1888 Roberts in England, using a 20-inch reflector with mirror by Grubb, began a long series of photographs of nebulæ and star-clusters. Common's and Roberts' work with reflectors aroused profound interest among astronomers, as did also the Henry brothers' work with refractors, for these were the first highly successful efforts in astrophotography with large instruments and with long exposures. Common's 37-inch reflector was bought by Crossley, and was presented by him to Lick Observatory in California, where about 1899 it was used by Keeler, with more refined methods than had hitherto been applied, in making a long series of exquisite photographs of faint nebulæ and star-clusters. As a result of these photographs Keeler was able to announce two discoveries of capital importance: First, that the spiral nebula is the prevailing or most numerous type of nebulæ; second, that hundreds of thousands of spiral nebulæ are within the reach, photographically, of such an instrument as the Crossley reflector. Keeler's epoch-making work was interrupted by his death in 1900, but since has been continued at the Lick Observatory by Perrine, Curtis and others.

In 1901 Ritchey completed the 24-inch reflector of the Yerkes Observatory, and in 1901 and 1902 secured with it a series of photographs of the remarkable changing nebulosity around the star *Nova Persei,* a work which was simultaneously carried on by Perrine at Lick Observatory. This nebulosity was so faint that it was invisible in all visual telescopes, and could be photographed successfully only with the great short-focus reflectors. Later Parkhurst and others used the 24-inch reflector with great success in stellar photometry.

In 1908, under Ritchey's superintendence, the 60-inch reflector of the Mount Wilson Observatory was completed and installed at the summit of Mount Wilson, California, nearly 6,000 feet above sea-level. This great instrument, designed especially for celestial photography in many lines, is unique in many respects, two of which may be mentioned: first, nearly the entire weight of the moving parts is floated in mercury, thus securing a very high degree of smoothness of motion in following the apparent motion of the heavenly bodies; second, a series of interchangeable ends of the telescope tube allows any one of a number of small mirrors, plane and convex, to be used in combination with the great mirror; by this means the telescope can be very quickly changed to any one of the various forms needed for the various kinds of work in celestial photography; the forms used are the Newtonian, the Cassegrainian and the *Coude.*

With this instrument used in a superb climate, and combining great size with great refinement of construction and the high photographic efficiency of the reflector, remarkable results have been secured in many lines of astrophotography. Adams and others have conducted epoch-making researches in stellar spectroscopy; Sears and Shapley have secured a long series of observations of the highest accuracy in stellar photometry; Van Maanen has made investigations of high accuracy in stellar parallax. Ritchey has made a series of photographs of spiral and other nebulæ and of star-clusters for the purpose of studying internal rotation and proper motion of these bodies. Fath and Pease have also made many fine direct photographs of nebulæ, and have made very long-exposure photographs of the spectra of nebulæ and star-clusters.

As an illustration of the degree of refinement attained in astrophotography with such an instrument as the 60-inch reflector, the attachment used in direct photography, and illustrated in Fig. 1, may be briefly described. It is the improved double-slide plate-carrier, developed by Ritchey from the simple form devised by Common. The telescope tube of course moves by clock-work to follow the apparent motion of the heavenly bodies due to the earth's daily rotation. This motion of the telescope is marvelously smooth and accurate, but is nevertheless far from being accurate enough to suffice, alone. To secure the sharpest attainable photographs the observer must watch, throughout the entire time of exposure of the sensitive plate, a suitable guide-star as close as possible to the object being photographed; this is done by means of a high-power eye-piece or microscope with illuminated cross-lines of spider-web at its focus. Minute corrections of position are constantly introduced by the observer by means of two screws, the large milled heads of which are held in the observer's fingers; these screws move the two slides, at right angles to each other, which carry the plate-holder. A second guiding eye-piece, on the opposite side of the plate-holder, is also used to permit the detection and correction of any slight rotation of the field; this rotation is certain to occur in an instrument as powerful and sensitive as the 60-inch, and long-exposure photographs would be ruined by it unless such corrections were introduced. Furthermore, as the length of the steel tube of the telescope changes slightly with temperature throughout the night, the focal plane of the mirror changes slightly with reference to the plane of the photographic plate. Hence an accurate method of refocussing is used, by which this relative change is corrected at frequent intervals. With these refinements very long exposures on excessively faint objects can be continued hour after hour and night after night with the certainty that no errors can occur which could injure the sharpness of the photographs. Two concrete examples will illustrate the results secured by these methods. A photograph of the spiral nebula Messier 33 *Trianguli,* taken with an exposure of 8½ hours, shows over 26,000 nebulous stars undoubtedly belonging to the nebula itself, besides about 3,500 other stars not nebulous, which lie between us and the nebula; all of these are within an area of the sky 30 minutes of arc square. A photograph of the globular star-cluster Messier 13 *Hercules,*

with 11 hours' exposure, shows by actual count over 30,000 stars in the cluster, outside of the dense central region in which the star-images to some extent superpose, and where counting is therefore impossible; photometric measures show, however, that at least an equal number of stars are present in this dense central region. In the latter photograph the faintest stars shown are of 21½ magnitude; this is five magnitudes, or approximately 100 times, fainter than the faintest stars which can be seen (visually) in the largest visual refractors. In the best of these photographs the fainter star-images are less than one second of arc in diameter.

Another illustration of the extraordinary results in astrophotography made possible by the great modern reflecting telescopes is the recent discovery of numbers of very faint novæ or "temporary stars" in the spiral nebulæ. These stars apparently correspond in all respects to the novæ which occur in our own stellar system or galaxy; they form another link in the chain of evidence tending to show that some of the spiral nebulæ, at least, are other stellar systems similar to our own. A comparison of the average brightness of all of the novæ which have occurred in our own galaxy (about 5½ magnitude) with the average brightness of all of those which have recently been discovered in the photographs of spiral nebulæ (about 14 magnitude), affords what is at present the most reliable method of estimating the average distance from us of the spiral nebulæ, as compared with that of the novæ in our galaxy; this relative distance is thus shown to be of the order of 50 to 1.

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ASTROPHYSICS, or the new astronomy, the science dealing with the physical nature of the heavenly bodies, has revealed in a remarkable manner, through its discoveries during the last half-century, the wonderful ability and resourcefulness of the human mind. By means of the spectroscope we have been able to investigate the physical constitution of the sun, planets and far-off stars; it has become possible to measure motions, not athwart the sky as the older astronomy was able to do, but to or from the observer in the line of sight; and it has been possible to arrange the stars in orderly series, tracing their evolution from the primæval nebula, till now we are well on the way toward the solution of the grandest problem of human investigation, whence came we and whither are we going? Since its birth in 1859, when Kirchhoff discovered the principles of spectrum analysis, astrophysics has advanced with great rapidity, due to the improvement of instruments and to the application of the photographic plate. This important acquisition has a two-fold advantage over the human eye: the eye can receive and retain an impression for a small fraction of a second only; the photographic plate accumulates impressions, no matter how faint, with the result that by long exposures there is brought to view objects the eye could never hope to see; and secondly, the photograph gives a permanent record that can be examined and studied at leisure.

Instruments.— A spectrum is produced either by a prism or a grating. With prisms, increased dispersion is obtained by additional prisms. In work on the sun, before the use of gratings, it was quite common to employ 20 or more prisms. Gratings were used as early as 1815 by Fraunhofer and were made by winding fine wire over two exactly similar screws. Rutherfurd of New York ruled some very satisfactory gratings on speculum metal. A diamond is used as the ruling point and the plate to be ruled is moved by means of a screw. The character of the grating depends on the excellence of the screw. Rowland of Johns Hopkins University made a dividing engine of such accuracy that he was able to rule six-inch gratings with 20,000 lines per inch. The splendid definition of Rowland gratings has never been surpassed. Rowland made the brilliant discovery that if the grating were ruled on a concave surface the spectrum could be focussed without the use of collimator or camera lenses. By the elimination of these lenses not only was the sharpness of definition increased but the region of short wave-lengths could be investigated. This vast increase in accuracy, coupled with other properties of the grating, namely, normal spectrum, overlapping spectra and astigmatism, whereby comparisons are rendered easy by coincidences, have wonderfully augmented the power of the astrophysicist to determine accurate wave-lengths. The concave grating thus marked a new epoch in the history of spectroscopy. The formula for resolving power which is defined as $\gamma = \frac{\lambda}{\lambda a}$, where $a\lambda$ is the difference of wave-length of two lines of mean wave-length λ which can just be divided, can easily be expressed for a grating and is the product of the total number of lines of the grating and the order of the spectrum. Ordinary six-inch Rowland gratings have a resolving power of about 400,000. Rowland's dividing engine was not capable of ruling gratings greater than six inches in diameter. Quite recently Michelson of the University of Chicago and Anderson of the Carnegie Solar Observatory have succeeded in ruling 10-inch gratings with an accuracy quite comparable with that attained by Rowland. A grating of different form is the echelon invented by Michelson, made by putting together glass plates of uniform thickness. By this means Michelson has obtained a resolving power as great as 900,000. The precision of wave-lengths has been still further increased by the use of interferometres. Four different kinds have been invented by Michelson, Perot and Fabry, Hamy, and Lummer and Gehrcke. Michelson has been able to compare directly the wave-lengths of the prominent cadmium lines with the International Metre (Michelson, 'Light Waves and Their Uses,' 1903), and has separated lines less than 0.01 tenth-metre apart which appear single in the most powerful gratings, while Perot and Fabry have observed interference with the green mercury line at a difference in path of 790,000 wave-lengths.

Wave-lengths.— The unit generally used in the measurement of wave-lengths is the Angstrom, or tenth-metre, or metre divided by 10^{10}. A great change has recently come over our ideas of the wave-length. Formerly

the wave-length was looked upon as an invariable property of a line in the spectrum, unalterably fixed by nature, and consequently it was thought that a wave-length determination would give a standard measure of distance more reliable even than that obtained by the use of the International Metre (Michelson, 'Astronomy and Astrophysics,' XIII, 92, 1894). But we now know that the position of the lines in the spectrum may vary with the pressure of the gas in which they are produced, and moreover, single lines, by the action of a magnetic field, have been separated into as many as 19 different components. The shift in the lines of the spectrum due to motion in the line of sight, which has been shown experimentally in the laboratory, has given rise to many interesting developments in astrophysics, the discovery of an entirely new class of stars called spectroscopic binaries, the measurement of the axial rotation of the sun and Jupiter, and has confirmed in a magnificent manner the meteoric constitution of Saturn's rings.

Spectra of the Elements.— The invention of the concave grating and the manufacture of nearly perfect gratings, plane and concave, by Rowland, enormously increased the accuracy of the wave-lengths in the spectra of the elements. The chief investigations in this field have been carried on by Rowland and his assistants, by Kayser, Runge, Paschen, Hasselberg, Liveing and Dewar, Eder and Valenta, Exner and Haschek, Hartley and Adeney, Trowbridge, Ames, Lockyer, Deslandres, Lohse and others. The most complete tables of wave-lengths are those of Exner and Haschek, in which the wave-lengths are given to 0·01 Angstrom. Other tables are Watt's 'Index of Spectra.' The standards on which all wave-length tables are based are Rowland's 'Table of Solar Spectrum Wave-Lengths,' which were based on Bell's determination of absolute wave-length, *American Journal of Science*, XXXIII, March 1887. For a discussion of methods of determining wave-lengths consult Perot and Fabry, 'Ann. Chim. et Phys.,' ser. 7, XV, 1899, also XXV, 1902, and Bell (*Astrophysical Journal*, XV, 157, 1902). The infra-red spectrum of the elements has been investigated by prism and concave grating with the help of bolometer and radiomicrometer by Snow, Lewis, Rubens, Paschen, Julius, Nichols and others. Short wave-lengths are absorbed by even a few centimetres of air, but Schumann ('Sitz. Akad. d. Wissens. in Wien,' CII. Abth. 2a, 1893), has greatly increased our information of this region of the spectrum. By means of a spectroscopic apparatus in a vacuum with lenses and prisms of fluorite and photographic plates prepared by himself, a wave-length of λ 1,000 was supposed to be reached. More accurate wave-lengths have been determined by Lyman of Harvard, using a concave grating in a vacuum and photographic plates poor in gelatine, as shown by Schumann. Lyman has reached as short wave-lengths as λ 600 (*Astrophysical Journal*, XLIII, 89, 1916), and the limit of short wave-lengths can probably be pushed still farther by this same method.

Line Series.— That there is some orderly arrangement in the lines of a spectrum was shown by Balmer's law for the hydrogen series in 1885, and by the presence of numerous triplets in the spectra of magnesium, calcium and zinc. Researches by Kayser and Runge, Rydberg and Schuster, with the development by them of empirical and mathematical formulæ, have led to a great deal of interesting information regarding these series of lines. Our knowledge of the spectrum of hydrogen is derived mainly from the observations of the heavenly bodies. In the laboratory, comparatively few lines are found in the series obeying Balmer's law, but these lines are well shown in the spectra of hydrogen-type or class A stars, and as many as 32 lines of this series have been measured by Mitchell in the eclipse spectra of the sun. The further interdependence of astronomy and physics was clearly demonstrated when Pickering in 1896 discovered a new series of lines in the spectrum of the star ζ Puppis. It was not till 1892 that Fowler of London succeeded in finding in the laboratory some lines of the ζ Puppis series, and also λ 4686, and other lines of the Principal series of hydrogen. At the same time Fowler discovered a second Principal series of hydrogen, and comes to the conclusion that "there are no special kinds of matter in celestial bodies and that most, if not all, of the celestial spectra are well within range of laboratory experiments." ("Monthly Notices," R. A. S., LXXIII, 62, 1912). However, in a great majority of the elements the series already discovered comprise only a small percentage of the total number of lines. The exact meaning of these series is as yet unknown, although several very promising attempts have been made to explain them from theoretical considerations. The chief among them may be mentioned those of Julius, Ames, Kövesligethy and Stoney. Stoney ('Trans. Roy. Soc.,' Dublin 1891) has sought to explain multiple lines from dynamical considerations, comparing the motions of the molecule with those of the bodies of the solar system whose motions in ellipses are perturbed by the presence of other bodies. Stoney, moreover, shows that the conclusions drawn by these dynamical methods may also be considered valid under the electro-magnetic theory of light, a statement which receives support from Preston's observations of the Zeeman effect (*Philosophical Magazine*, XLVII, 176, 1899). For detailed information on spectral series consult Kayser's 'Handbuch der Spectroscopie' Vol. II.

Change in Physical Conditions.—The early idea that the position of a line of a spectrum was the result of chance is still further modified by the change of the wave-length of a line resulting from a change in the physical conditions. Jewell noticed while measuring solar spectrum photographs that the arc lines of the comparison spectrum did not in many cases exactly correspond with the lines in the sun. This led to the investigations of Jewell, Humphreys and Mohler (*Astrophysical Journal*, VI, 169, 1897), on the spectra of an arc under pressure of from one to 15 atmospheres. From measurements of the spectra of 53 elements, it was shown that the lines are shifted by pressure toward the red end of the spectrum, the amount of the shift being directly proportional to the increase of pressure, but being independent of the temperature. For a given element, the shifts of similar lines are proportional to their wave-length, but lines of

different series, principal, first and second subordinate, are shifted in the ratios of 1:2:4.

The appearances of lines in a spectrum are greatly altered by other physical conditions. Eder and Valenta have found that argon gives three distinct spectra under different electrical conditions, Schenck that the spark line of Mg at λ 4481, which has so often been considered as a sure sign of a high temperature, vanishes if the electrodes become so hot that they glow and begin to melt. Lockyer has made a great number of investigations on "enhanced" lines, or those which are brighter in the spark than in the arc. He explains their meaning on the assumption that the spark is hotter than the arc, an assumption which is hard to reconcile with other observed phenomena. In this connection, Kayser, in his excellent 'Handbuch der Spectroscopie,' Vol. II, p. 181, says: "We cannot assume any connection between the spectrum and the temperature of the body producing it, and all conclusions which are based on the temperature at which a line or band will appear are quite unsound." Enhanced lines are found in the spectrum of certain stars like α Cygni, and also in the flash spectrum taken at the time of a total solar eclipse of the sun. Evershed of India, and the observers at Mount Wilson, Adams, Gale and St. John, recognize the importance of enhanced lines in the interpretation of solar phenomena. Observations of solar spectra, with and without an eclipse, point to the conclusion (*Astrophysical Journal*, XXXVIII, 407, 1913), that "the vapors forming the enhanced lines ascend to relatively high altitudes from which there results a decrease in pressure and a mixing with hydrogen, and that on account of height, reduced pressure and the presence of hydrogen, the enhanced lines become relatively strong.

Solar Spectrum.—The infra-red solar spectrum has been investigated by Becquerel and Lommel to λ 9500 by using phosphorescent screens, by Abney to λ 27,000, who photographed with a special emulsion of silver bromide and collodion, and by Langley by the use of the bolometer to λ 53,386. Rowland's 'Photographic Map of the Normal Solar Spectrum' (Baltimore 1888), made with a powerful concave grating extending from λ 3000 to λ 6950, and his 'Table of Solar Spectrum Wave-Lengths' (Chicago 1898), which contain accurate measures of some 20,000 lines, give the most accurate information we possess of the solar spectrum, and have been accepted by all astrophysicists as the common standard of reference. Rowland's determinations of relative wave-lengths leave little to be desired in accuracy. Measures were made by the method of coincidences which is rendered possible by the use of concave gratings which permit two overlapping spectra to be photographed on the same plate without change of focus. However, the standard lines of the spectrum have not had their wave-lengths determined with equal accuracy, and they have not been quite properly spaced throughout the spectrum, with the result that at the Saint Louis conference, 1905, a redetermination of Rowland's standards was regarded as one of the present greatest needs in astrophysics. Considerable work has already been done toward obtaining the wave-lengths of 200 standard lines to be reduced to the so-called "international system." This work has made evident the difficulty of obtaining satisfactory wave-lengths for the standard lines on account of a slight change in wave-length due to a change in physical conditions. Although the systematic deviations of Rowland's wave-lengths from the international system amounts to 0.02 Angstroms or more, the accidental errors are much less than 0.01 Angstrom. As present-day investigations of solar problems need the third decimal place in the wave-lengths, St. John concludes ('Proceedings' of the National Academy of Sciences, April 1916), that it will be more satisfactory to reduce all wave-lengths to the Rowland standard until some years hence, when complete tables of solar wave-lengths based on the new standards will be available.

The importance of a detailed study of our nearest fixed star, the sun, has been emphasized by the erection by the Carnegie Institution at Washington of the Solar Observatory at Mount Wilson. The discoveries at this observatory have been epoch-making. The work at Mount Wilson has demanded (1) a large image of the sun; (2) that spectrographs be kept under as nearly constant conditions of temperature as possible. Hence there has been the erection by Hale of the "tower telescope." There was first erected a 60-foot tower, and this proving successful, there was later put up a tower 150 feet high. A beam of sunlight reflected from a plane mirror at the top of the tower passes through an objective and is brought to a focus on the slit plate of the spectrograph. From the slit, the beam passes vertically down a 75-foot well, at the bottom of which is placed a concave grating. The splendid definition obtained in California, and the great dispersion of the large spectrograph, have permitted a detailed study of spots on the sun. The work of Hale has shown (1) that sunspots are cooler than the rest of the sun; (2) that the spots are vortices; (3) that they are centres of magnetic disturbance. These facts have been verified only after a great variety of experiments carried out at Mount Wilson and at the Solar Observatory Office in Pasadena.

Eclipses have furnished interesting developments in the history of spectrum analysis. The spectroscope was first used at the eclipse of 1868 by Janssen in India, when it was shown that the prominences give a bright line spectrum, thus showing that they are masses of gas. The lines appeared so bright in the spectroscope that Janssen looked for them the next day without an eclipse and found them readily enough. In 1869 helium was discovered on the sun, though it was not found in the laboratory by Sir William Ramsay till 1895; in 1870 Young discovered the "flash spectrum."

Observations similar to Janssen's of 1868 were independently carried out by Lockyer in England, who found the prominences without the aid of an eclipse. Both communicated their results to the French Academy, and by a strange coincidence both papers were read at the same meeting of the Academy. Prominences thus ceased to be purely eclipse phenomena. Valuable observations were made by Young, who used visual methods. In 1890 Hale invented the spectroheliograph, by means of which it was possible to photograph the prominences. Quite independently, Deslandres of Paris in-

vented a similar instrument. The essential feature of the spectroheliograph is the second slit, which is placed directly in front of the photograph plate and is used to allow light of only one wave-length to reach the plate. Hale's spectrohcliograph reached its highest development on the 40-inch Yerkes telescope. By setting the second slit on a certain line of the spectrum it was possible to photograph the prominence in the light of that line only. Photographs could thus be obtained in the light of glowing calcium vapor by utilizing the H or the K line of calcium, or from glowing hydrogen using the C or H α line. The exquisite defining power of the 40-inch lens has permitted remarkable detail to be shown in the prominence photographs. At times prominences reach the great elevations of 300,000 miles above the sun, and are shot up with velocities as great as 100 miles per second. The chief workers along these lines have been Hale, Deslandres, Evershed, Fox, Slocum and Ellerman. They all have shown that prominences are intimately associated with sun spots.

In photographing the surface of the sun by means of the spectroheliograph, Hale discovered bright patches of gas which he called «flocculi.» In his investigations of flocculi, Hale found that the photographs showed different appearances when the slit was shifted to a slight amount from the centre of the line of the spectrum which was being utilized. A photograph may be taken with the slit of the spectroheliograph at the centre of the K line at λ 3933.8, another with the slit moved a trifle to λ 3932, and still others with the slit at λ 3929 and λ 3924. These photographs show bright «flocculi,» but the four of them not only differ from photographs taken with the calcium H or with hydrogen C or F lines, but differ materially among themselves. These photographs are explained as being due to a difference in level of the gases, and from these and other results it seems probable that the calcium flocculi are in general made up of a series of columns, which expand as they reach higher levels, and in many cases overhang laterally. Both prominences and flocculi may be photographed by a spectroheliograph attached to a horizontal telescope in which the light is fed to the objective by means of a plane mirror, as Hale has shown at Mount Wilson and Evershed in India. These horizontal telescopes, however, do not equal the definition obtained by the 40-inch telescope.

The dark Fraunhofer lines of the solar spectrum are caused by the absorption of light as it passes from the hot photosphere through the relatively cooler layers of atmosphere surrounding the photosphere, the so-called «reversing layer.» The gases forming the reversing layer are cool only in contrast to the very hot matter making up the photosphere, but these gases, nevertheless, are at such a high temperature, that if we could obtain their spectrum separated from the photosphere, the spectrum would consist of a series of bright lines on a dark background. At the time of a total eclipse of the sun, we are permitted to obtain the spectrum of the reversing layer. So long as even a small portion of the sun's disc remains visible, the light from the photosphere is so overpowering compared with that of the reversing layer, that the ordinary, dark-line Fraunhofer spectrum is obtained. Just before totality a few bright lines of the upper chromosphere become visible, first the H and K lines of calcium, and these are followed by the hydrogen and helium lines. At the instant that the sun's disc is entirely covered by the moon, there flashes out the bright line spectrum of the reversing layer. The change from dark-line to bright-line spectrum is so rapid that Young in 1870, who was the first to see it, called it the «flash spectrum.» The flash remains visible in its entirety only for a few seconds, while the moon is passing over the relatively shallow reversing layer. The flash spectrum was first photographed in the year 1896 by Shackleton, who used a prismatic camera. The most complete results so far published are those of Mitchell, who obtained exquisite definition on his photographs at the 1905 eclipse. The apparatus used was extremely simple, and consisted of a plane mirror to turn the sun's light horizontally. From the mirror, the beam of light fell on a concave grating by means of which the spectrum was brought to a focus on the photographic plate. No slit was used. Photographs were obtained extending from λ 3300 in the violet to λ 5900, with a dispersion of one mm equal 10.8 Angstroms. The wave-lengths of 2841 lines in this region (*Astrophysical Journal*, XXXVIII, 407, 1913), show an accuracy of 0.02 Angstroms. In addition to the wave-lengths, there were also given the heights to which the vapors forming each line of the spectrum extend in kilometres above the sun's photosphere. The general conclusions from this eclipse work are: (1) That the reversing layer is merely the densest part of the chromosphere, and has no existence separate from the chromosphere; (2) that the reversing layer extends about 600 kilometres above the photosphere; (3) that there is no difference in wave-lengths between the spectrum of the reversing layer and Rowland's values for the Fraunhofer lines, showing that in reality the flash spectrum is truly a reversal spectrum; but (4) there are great differences in intensities between the lines of the flash spectrum and the Fraunhofer spectrum. These intensity differences find a ready explanation in the differences in height to which the vapors extend. On account of the great heights, the H and K lines of calcium, the hydrogen series, and the helium lines are all strong in the flash spectrum. Very great differences in intensity are shown by the enhanced lines.

Prominences are merely portions of the chromosphere shot up to great heights above the sun. Since we are able to photograph the prominences without waiting for an eclipse, would it not be possible to obtain a photograph of the chromosphere, even of the portion that lies closest to the photosphere, the reversing layer, which produces the flash spectrum? Young many years ago observed the brighter chromosphere lines without an eclipse. Evidently it would be quite possible to photograph the flash spectrum provided that during the exposure the slit could be held pointed at the reversing layer, and the photosphere not be allowed to encroach. An idea can be obtained of the accuracy demanded in pointing the slit to the proper region on the sun when it is realized that the sun is 866,000 miles in diameter, while the reversing layer is less than 400

miles in thickness. To photograph the flash spectrum without an eclipse, there is hence needed a large image of the sun, and some convenient guiding device. Hale and Adams, using a very ingenious arrangement and the 60-foot tower telescope, have obtained the only photographs of the flash spectrum without an eclipse. Using a dispersion of 1 mm equal 0.9 Angstroms, excellent photographs have been obtained which show about as many lines as secured by Mitchell with an accuracy of wave-length about the same as that obtained by him.

Success, however, has not followed the attempts to photograph the corona in full sunlight without an eclipse. This was tried as early as 1885 by Sir William Huggins. In 1893 and 1894, Riccó at Mount Etna, and Hale at Pike's Peak, attempted to photograph the corona, both by direct photography and also bv the spectroheliograph, which has been so successful in obtaining photographs of the prominences. Failure to reach results, turned Hale's attention to the bolometer joined up with a sensitive galvanometer, and many experiments were made at Yerkes Observatory between the years 1895 and 1900 (*Astrophysical Journal,* I, 372, 1900). The cause of the failures is shown from the measures at the eclipse of 1908 by Abbot with the aid of the bolometer. The work of Abbot ('Sun,' p. 132, 1911) shows that the davlight sky as seen from sea-level even 20° from the sun is fully 10 times as bright as the corona in its brightest parts close to the sun's limb. Close to the sun's edge the daylight sky is so intensely brilliant compared with the corona, that no method yet attempted, even when tried at a mountain top to diminish the atmospheric glare, has had the slightest amount of success.

Remarkable work has been done by Evershed in measuring the radial motion of matter forming sun-spots. With the better equipment at Mount Wilson, St. John has carried out Evershed's work more in detail. His researches (*Astrophysical Journal,* XXXVIII, 341, 1913) have been supplemented by the determination of heights by Mitchell from observations at the time of an eclipse. These results show that the different displacements of the Fraunhofer lines at the edges of sun-spots seem to find their simplest explanation in movements of the solar vapors tangential to the solar surface with velocities varying with the elevation: large outflowing displacements are taken by vapors that exist at low heights while large inflowing motions are taken by vapors like calcium and hydrogen which exist at great heights. This excellent work of St. John's gives a very clear insight into the physical constitution of sun-spots. The lighter materials of the chromosphere which cause the darkest lines in the sun's spectrum, hydrogen, helium, calcium and substances forming the stronger enhanced lines, flow in to the spots, the higher the elevation above the photosphere the greater the speed of the in-flow. This in-flow of matter is partly balanced by the out-flow of matter from the spot, matter at the least heights above the photosphere flowing with the greatest velocities. The spot vortex, therefore, resembles in appearance that of an inverted water-spout seen in a terrestrial storm. In addition to giving great information regarding sun-spots, St. John's work coupled with eclipse observations has given the means of measuring the depths of the layers of gases forming the inner chromosphere, while Hale's wonderful researches on flocculi can be interpreted only by assuming differences of elevations in the outer chromosphere. We therefore seem to have more information concerning what is happening at different elevations in the sun's atmosphere than what is taking place in the earth's atmosphere in spite of the great improvements in methods of observing meteorological phenomena.

Motion in the Line of Sight.— One of the greatest triumphs of astrophysics has been the measurement of radial velocity, or motion in the line of sight, in linear units of miles or kilometres per second. The Doppler-Fizeau principle is easy to understand. Light is a wave phenomenon. When the source of light and the observer are approaching each other, either by a motion of the object, or the observer, or both combined, then the number of waves which reach the eye per second is increased, while if the observer and object are moving from each other, fewer light waves reach the eye per second. If more waves are met, the wave-length must be shortened. The position of a line in the spectrum is known by its wave-length, and, if in consequence of motion, the wave-length is shortened, the position of the line is shifted toward the region of short wave-lengths, the violet. The measurement of the amount of the shift gives the means of determining the velocity in the line of sight. Consequently, a shift toward the violet means a motion of the object toward the observer (the motion taking place either in the object, or in the observer, or both), while a shift toward the red means a motion increasing the distance between observer and object. This is the Doppler-Fizeau principle. All are familiar with this same principle in sound, in the sudden drop in the pitch of the whistle of a locomotive as a train going in the opposite direction is met and passed. The motion in the line of sight corresponding to a shift $\Delta\lambda$ of a spectral line of wave-length λ is given by the formula

$$\sqrt{}_s^{\wedge} = \sqrt{}_i^{\wedge} \odot \frac{\Delta\lambda}{\lambda}$$

Where $\sqrt{}_s^{\wedge}$ is the velocity of the star relative to the observer, and $\sqrt{}_i^{\wedge}$ is the velocity of light. If the velocity of light is measured in miles per second (186,300), the velocity $\sqrt{}_s^{\wedge}$ is known in miles per second. In scientific work velocities are usually determined in kilometres per second, when the velocity of light (in round numbers) is 300,000. One can easily see, therefore, the accuracy necessary in the measurement of spectrograms in order to attain knowledge of radial motions of stars to a given degree of refinement. If, for instance, we wish to know the velocity in the line of sight accurately within one kilometre per second, it will be necessary to determine wave-lengths with a precision of one part in 300,000. For a line of wave-lengths λ 4500, it is necessary to measure the shift in wave-lengths within 0.015 Angstroms. This accuracy is reached in the best work done with our best spectrographs, when the spectrum of the star being investi-

gated consists of fine, clean-cut lines. With a slit spectrograph a comparison spectrum is placed alongside the stellar spectrum. From the known wave-lengths of the comparison lines the wave-lengths of the stellar lines may be found, and these, compared with the normal wave-lengths, give the shift due to the motion of the star in the line of sight. The grandest application is seen in Keeler's proof (*Astrophysical Journal*, I, 416, 1895) of the meteoric constitution of Saturn's rings. If meteoric, the linear motion of the rings will be greatest nearest the planet and decrease outward; if solid the rings will rotate as a whole, all particles having the same angular motion, the linear speed increasing from centre to circumference. With solid rings and a slit placed across the planet's equator, the lines on the side moving toward us would be shifted toward the region of short wave-lengths, the shift being proportional to the linear motion, while for the side moving away from us the lines would be shifted in the opposite direction. Thus, on account of the gradual increase in linear motion from centre to circumference, the lines would be gradually shifted, in the complete spectrum having the effect of lines slightly inclined. Such, however, is not the appearance of the lines photographed by Keeler, and these can be explained only under the assumption that the rings are a collection of small satellites, giving, therefore, a direct confirmation of the mathematical theory of Maxwell.

One of the most interesting applications of the Doppler-Fizeau principle is the determination of the rotation periods of the sun and the planets. As the sun rotates the eastern edge moves toward us while the western moves away from us. Measurements of the rotation of the sun have been carried out mainly by Halm of Edinburgh, Plaskett at Ottawa, and Adams at Mount Wilson. The rotation time at the sun's equator is found to be 24.8 days; at latitude 30°, 26.3 days; at latitude 45°, 28.1 days; at latitude 60°, 30.2 days; and at latitude 75°, 31.9 days. Adams used more than 20 lines of iron, titanum, manganese, etc., and he found that the different elements do not all show the same rotation period. The differences, according to Adams, can be explained as being due to differences of level of the layers producing the different lines. Most interesting are the results from the H α line which shows a rotation period at the equator of 24.0 days instead of 24.8, and at latitude 75°, a rotation in 26.3 days instead of 31.9 days, as shown by the metallic lines at the same latitude. Hale has investigated the rotation time by means of the flocculi. The calcium flocculi show a decrease in rotation speed in higher latitudes, just as is shown by the spots, but in a lesser degree, while on the other hand the hydrogen flocculi H δ show an increase from a rotation speed of 25.2 days at the equator to 24.7 days in middle latitudes. There is still a vast amount of work left to be done before a thorough knowledge is obtained of the manner of rotation of the sun.

In investigating the rotation of the planets, most satisfactory results are obtained from Jupiter. On account of its great size and rapid rotation, a point on Jupiter's equator moves with a speed of 12½ kilometres per second. If the slit of the spectrograph is placed across the planet, parallel to the equator, the lines of the spectrum will be inclined on account of the great rotational velocity. Although the planet Uranus shows no conspicuous markings, and its rotation time, therefore, cannot be determined from visual observations, Lowell and Slipher have been able to show from spectroscopic observations that it rotates once in 10¾ hours, and in the retrograde direction, or in the same direction that the satellites move about Uranus. Applied to Venus, the spectroscopic method has not had the same degree of success due to the fact that the linear motion from rotation is small, and, consequently, difficult to measure. While Slipher finds the rotation period to be 225 days, thus corroborating the results obtained visually by Schiaparelli and Lowell, Bélopolsky in Pulkowa finds a period of about 24 hours.

Water Vapor on Mars.— According to Percival Lowell there are a great number of canals on Mars which are for the purpose of irrigating the arid planet. As there is very little water visible on the surface of Mars, Lowell concludes that the atmosphere is rich in water vapor. This is a matter that can be investigated spectroscopically. Since the moon has no atmosphere, it shows the same spectrum as the sun. In coming from the moon, rays of light pass through the earth's atmosphere, so that its spectrum might show atmospheric lines due to the earth's water vapor. When light reaches us from Mars the rays from the sun have twice passed through the atmosphere of Mars. If the spectrum of Mars is compared with that of the moon, care being taken that the two spectra are observed under as nearly as possible identical conditions regarding altitude, the presence of water vapor in the earth's atmosphere, etc., then if the atmosphere of Mars is rich in water vapor, these lines should show by increased absorption at the red end of the spectrum. Slipher believes that he has proved this to be the case. Campbell, under vastly superior conditions, observing from the top of Mount Whitney (15,000 feet), finds that the spectra of Mars and moon are identical. Campbell has also tested this matter in a different manner, but with negative results. The water vapor lines resulting from the earth's atmosphere should show a different radial velocity from those formed by the Martian atmosphere, since Mars is moving. Although the terrestrial atmospheric lines were found and measured by Campbell, there were none found due to Mars.

The Solar Constant.— Astrophysical work along entirely different lines has been carried out at the Astrophysical Observatory of the Smithsonian Institution for the purpose of determining the value of the solar constant, or the amount of heat from the sun that reaches the outside of the earth's atmosphere. The amount of heat received at the surface of the earth is measured by means of the pyrheliometer or actinometer. It is very difficult to eliminate the absorbing effect of the earth's atmosphere. Abbot has shown that this can be accomplished by the use of the bolometer, invented by Langley and used in connection with a sensitive galvanometer. The bolometer and galvanometer, both perfected in the hands of Abbot, are used to measure the energy at different regions of the spectrum of the sun. The determination made by Langley from the

top of Mount Whitney placed the value of the solar constant at 3.0 calories. More complete observations have been made by Abbot at Washington at sea-level, at Mount Wilson at an altitude of 5,700 feet, at Bassour in northern Africa, 3,900 feet, and at Mount Whitney in California at an altitude of 14,500 feet. Observations nearly simultaneous have been carried on at Washington and Mount Wilson, and also at Bassour and Mount Wilson, though these latter places are separated in longitude by one-third of the earth's circumference. These measures have been supplemented by observations with a pyrheliometer in a manned balloon which reached the altitude of nearly 25,000 feet, where the pressure of the atmosphere was 298 mm. of mercury, and also by pyrheliometer observations in a free balloon, which reached the great height of 72,000 feet at a pressure of 30 mm. of mercury. Observations along parallel lines have been made by Abbot for the purpose of investigating the absorption of the gases forming the solar envelope. The results from 1,000 determinations of the solar constant have proved conclusively that the so-called constant of solar radiation is 1.93 calories per square circumference per minute, that this value is not a constant, but that it varies as much as 10 per cent, that this variation is caused by changes in the absorption of the sun's atmosphere, and that as a result of these variations in the amount of heat sent out by the sun, there are parallel changes in terrestrial temperatures. The interdependence of these variations brings to view one of the most important developments of astrophysics. That terrestrial temperatures should be shown to be so closely connected with variations in the sun's heat is very remarkable; it would be very valuable if it were possible to forecast temperatures on the earth as a result of solar observations — a result which is not impossible.

Stellar Spectra.— Due to the fact that gratings spread the light into a number of orders of spectra, prisms are almost exclusively used in stellar investigations. A prism may be combined with the telescope, either with or without a slit. If without a slit the prism is placed outside the objective. In such a combination the dispersion is usually not very great. At Harvard College Observatory, where the best work with this method has been done, Pickering combines a prism of 15° angle with an objective of 11 inches aperture. In this manner are obtained spectra of a large number of stars at one time. To increase the width of the photographed spectra, the prism is mounted with its edge parallel to the celestial equator, and the clock-work driving the telescope is rated so as to run a little slow, or fast. To increase the dispersion, a second or third prism may be added. With the objective prism, it has so far been impossible to obtain radial velocities with the accuracy that is attained with a slit spectrograph, though Pickering has superimposed some very satisfactory additional lines in the stellar spectra by means of the absorption of neodymium. When a slit is used, it is placed at the focus of the objective. After passing through the slit the light passes through the collimator lens, from which it emerges parallel. The light is refracted by the prism, or prisms, and is brought to a focus by the camera objective, so that the spectrum may be photographed or viewed with an eyepiece. Photography is almost exclusively used in modern work. One, two or three prisms may be used to obtain dispersion. Needless to say, increase in the dispersion adds to the time of exposure necessary to obtain a photograph.

Modern stellar spectroscopes are best represented by the Mills spectrograph of the Lick Observatory (Campbell, *Astrophysical Journal*, VIII, 123, 1898), by the Bruce spectrograph of the Yerkes Observatory (Frost, *Astrophysical Journal*, XV, 1, 1902), and that of the Astrophysical Observatory of Potsdam (Hartmann, *Zeitsch. für Instrum.*, December 1901). The spectrographs are similar in having the slit placed at the focus of the great telescope, and a dispersion of three prisms giving a total deviation of 180°. By means of a guiding eyepiece, it is possible to keep the star's light centrally on the slit during the exposure. Since this exposure may last for four or five hours, it is necessary, in order to have perfect definition, to keep the temperature constant. This is accomplished by means of an automatic temperature control which will keep the prisms of the spectrograph within 0.1° C. during an exposure, when outside in the dome the temperature may change by several degrees. A stellar spectrum is photographed alongside a comparison spectrum in order to determine wave-lengths more accurately, and to give measures of the motion in the line of sight, the most important work of stellar spectroscopy. The spectrograms are most readily reduced by the Hartmann-Cornu formula:

$$\lambda = \lambda_0 + \frac{c}{s - s_0},$$

where λ_0, c and s_0 are constants and s is the scale reading of the line whose wave-length is desired.

It needed little investigation of the stars to show that difference in color of the stars corresponded to differences in the character of their spectra. One of the best known classifications is that of Secchi, who divided the stars into the following types:

Type I.— White or blue stars, the spectrum characterized by the breadth and intensity of the hydrogen lines with metallic lines very faint. This type includes more than half the stars.

Type II.— Yellow stars like our sun, with spectra resembling that of the sun very closely, consisting of a great number of fine dark lines.

Type III.— Red and orange stars, including most of the variables. The spectrum is crossed by numerous dark bands or flutings, which are sharply defined on the blue side and shade off toward the red. α Orionis, Antares and o Ceti are good examples.

Type IV.— Deep reddish stars, all faint. The spectrum resembles that of Type III, but the flutings are reversed in direction, being sharply defined on the red side. 152 Schjellerup is the best example.

Pickering has added a fifth type to include many stars having bright lines in their spectra, and the planetary nebulæ.

Other satisfactory classifications are those of Vogel and Lockyer. The classification most used at the present time is the one devised at Harvard College Observatory. In this, not only are there the main classes, but also subdivisions of each class as, B0, B1, B2, B3, . . . B9. The main classes are:

Class O.— Stars with bright bands. Wolf-Rayet stars. Typical stars γ Velorum, ζ Puppis.

Class B.— Helium stars, represented by δ and ϵ Orionis.

Class A.— Hydrogen stars, represented by Syrius and Vega, and characterized by the great intensity of the hydrogen lines.

Class F.— Calcium stars, in which H and K have the greatest intensity; represented by δ Aquilæ and α Carinæ.

Class G.— Solar type, represented by the sun and Capella.

Class K.— Represented by Arcturus. There is a decrease in intensity at the violet end of the spectrum.

Class M.— Represented by β Andromedæ, α Orionis, α Hercules and Mira Ceti. Absorption bands are found in the blue-green.

Class N.—Similar to Secchi's type IV.

Miss Cannon of Harvard College Observatory has completed the classification of 250,000 stars according to the above system. This classification seems to represent successive steps in the evolution of the stars.

By common consent the nebula is regarded as being the primordial matter. The first stage of development is represented, according to Huggins ('Atlas of Representative Stellar Spectra,' London 1899), a masterpiece with superb illustrations, by a star like A of θ Orionis, one of the stars of the great nebula. Orion and helium stars are followed in development by the white stars of Secchi's first type. Evolution can be traced step by step, through stages like those represented by the stars α Lyræ, Sirius, Castor (fainter star), α Aquilæ, Procyon, γ Cygni, till we come to the fully developed second type star like Capella and the sun. Increased absorption at the violet end of the spectrum gives the red stars of Secchi's third and fourth types which, according to Huggins, develop in parallel lines. The period of increasing old age is evident from the carbon absorption bands, and it is easy to imagine this absorption increasing in amount till the whole light of the star is cut off. But even at this stage, when the star gives no light, the spectroscope is not powerless to follow, for if the dark star accompanies a bright one, its presence is revealed through a change in the motion of the line of sight. There has been quite considerable discussion as to which star, Sirius or the sun, is in the hotter stage of development. The color of Sirius, and the maximum in its spectrum being more toward the violet end than in the case of the sun, would seem to indicate a higher temperature. Huggins and a great many astronomers think that the sun is in the hottest state, but that the great absorption in its atmosphere, compared with that of Sirius, makes the color of the sun yellow.

All classifications of stellar spectra begin with white stars and end with red. If we interpret this as the result of a change in temperature corresponding to a progress in evolution, as shown by Wien's law, and if the intensities of the different regions of the spectrum are measured by a spectral photometer and Planck's energy equation is applied, as in the case of the sun, then we find the following approximate effective temperatures of the stars of the different classes: Class Oe5, 12,000° C; classes B and A, 10,000° C; class F, 7,500° C; class G, 5,500° C; class K, 4,000° C; and class M, 3,000° C. Other methods of evolution among the stars have been shown possible by Lockyer, Russell and others.

Motions of the Stars.— Proper motion is determined from meridian circle observations. The motions are measured in angular units of seconds of arc per year. The most complete work is the 'Preliminary General Catalogue' of Boss containing the proper motions of 6,188 stars. Radial velocities are measured by the spectrograph in linear units of miles, or kilometres per second. The most prominent workers in this field have been: Vogel, Dunér, Campbell, Frost, Bélopolsky, Hartmann, Schlesinger, Plaskett and Adams, who together have pretty thoroughly surveyed the northern hemisphere. Work in the southern hemisphere has been done by the Lick Observatory station at Santiago, Chile, and by the Cape Observatory in South Africa. In stellar spectroscopic work the advantage is shown of the great light-gathering power of the large modern reflecting telescopes. The advantage of the reflector over the refractor in this field of work is that there is no chromatic aberration, so the light of all wavelengths is brought to a focus on the slit. The small field of good definition, which the reflector shows in comparison with the refractor, is no drawback in spectroscopic work. With the five-foot reflector of Mount Wilson, it has been possible to photograph the spectra of stars as faint as the 12th magnitude, while with the 100-inch reflector, it will be possible to photograph the spectra of stars of the 15th magnitude, or even fainter. In addition to measuring the motion of the star toward, or away from, the observer in the line of sight, the spectrograph has permitted the discovery of an entirely new class of stars known as spectroscopic binaries. The first discovered was Mizar by Pickering, who noticed the periodic doubling of the lines of the spectrum. It is comparatively rare that both stars are of so nearly equal brightness that both show the stellar absorption lines. But when the motion of the star in the line of sight varies in amount (after eliminating the motion of the earth about the sun), this change in velocity is certain proof of the presence of a second body. Repeated observations of such stars permit the determination of their orbits. It is found that the periods have a wide range, from 0.19 days in the case of β Cephei, to 6.0 years as in α Orionis, this latter period being longer than that of the shortest period of a visual binary δ Equulei, which has a period of 5.7 years. Among the brighter stars, about one star in every four is found to be a spectroscopic binary.

The most complete work on radial velocities so far published is 'Stellar Motions,' Campbell, Yale University Press, 1913. Campbell has made the remarkable discovery that as the stars increase in age their velocities increase according to the following table:

Spectral Classes	Number of Stars	Average radial Velocities
O and B	141	8.99 km.
A	133	9.94
F	159	13.90
G and K	529	15.15
M	72	16.55

There is no satisfactory explanation of this curious increase of speed with age unless we

accept that of Adams (*Astrophysical Journal*, XLII, 172, 1915). The early type stars have smaller proper motions and are at much greater distances from us than the later type stars. Due to the fact that Campbell's work has been limited to stars brighter than 5.0 magnitude, he has, in consequence, measured stars of higher average velocities in the later types than in the earlier. Kapteyn has shown that there is an intimate connection between proper motion, radial velocity, magnitude and spectral type of the stars, and has derived empirical formulæ showing the connection. The most complete work in this field has been done by van Rhijn (*Astrophysical Journal*, XLIII, 36, 1916). This work shows very clearly that the early type stars belonging to the O, B and A classes on the average are much more distant than the stars belonging to the later types. Adams at Mount Wilson has gone a step farther, and has made the wonderful discovery ('Proceedings' of the National Academy, April 1916), that the relative intensities of certain lines in stellar spectra show changes depending on the absolute luminosity of the stars, and by means of measures of these intensities, Adams has been able to determine the parallaxes of the stars. The spectrum of the sun is almost identical with that of Capella, which shows that the sun is a star, rendered brighter and bigger on account of its nearness. The stellar magnitude of the sun is —26.4 on the same scale that Sirius is a star of magnitude —1.4. Thus, according to Newcomb ('Stars,' p. 27), the sun gives us:

10,000,000,000 times the light of Sirius.

91,000,000,000 times the light of a star of magnitude I.

9,100,000,000,000 times the light of a star of magnitude 6.

The square roots of these numbers show the number of times we should increase the actual distance of the sun in order that it might shine as a star of the corresponding magnitude. Under these conditions the distance and parallax of the sun would be:

Sirius;	Distance, 100,000:	Parallax, 2".06
Mag. 1;	Distance, 302,000:	Parallax, 0".68
Mag. 6;	Distance, 3,020,000:	Parallax, 0".07

From the large size of the parallaxes, it is evident that the sun must be a very small star in the heavens. But its nearness renders it a very important star, one in which we can study the second stage of stellar development in all its details.

Researches by means of radial velocity, proper motion and parallax determinations show the presence of groups of stars in the sky like the Taurus group, the Ursa Major group, etc., in which the stars are moving with motions that are equal and parallel. To the Ursa Major group belong all the stars of the «Dipper» except the two extreme ones, and also such widely separated stars as Sirius, β Aurigæ and α Corona. Such results show the necessity of co-operation among the different observatories in order that observational work may be done with the highest degree of accuracy. So far the weakest part of the measured values has been the parallax determinations. Recent work by means of photography with telescopes of great focal length has shown the possibility of greatly increasing the accuracy of parallax measures over the results obtained visually. Several American observatories possessing large telescopes, together with the Greenwich Observatory, are co-operating in parallax determinations. The American observatories are: Allegheny, Dearborn, McCormick, Mount Wilson, Swarthmore, Van Vleck and Yerkes.

The position of the apex of the solar motion is fixed by Weersma from the proper motions of 3,600 stars at right ascension 268° and declination, 31°, north, and by Boss from 5,400 proper motions deduced from his 'Preliminary General Catalogue,' at right ascension 271° and declination 34°, north. Campbell, from the investigations of the spectra of 1,047 stars, places the position at right ascension 272° and declination 27°, north. The motion of the solar system through space was found by Campbell to be 17.85 kilometres, or about 12 miles per second. This speed carries the solar system 255,000,000 miles per year, or 3.75 times the earth's mean distance from the sun.

Twentieth century astronomy will have as its special study more detailed information concerning the motions of the stars and their distances in order that more complete knowledge may be gained regarding stellar evolution, and regarding the shape and size of the universe, and the distribution and motions of the heavenly bodies forming it.

Bibliography.— The best books on the subject are Kayser's 'Handbuch der Spectroscopie' (6 vols.); Scheiners' 'Astronomical Spectroscopie' (Frost's translation); Campbell's 'Stellar Motions' and Newcomb-Engelmann's 'Populäre Astronomie.'

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ASTRUC, as'truk', **Jean,** French physician; b. 19 March 1684; d. Paris, 5 March 1766. He acquired high reputation as an anatomist, and was the author of 'Venereal Diseases' (1736), and other medical works. The work, however, which has immortalized him is purely theological and is entitled 'Conjectures as to the Original Materials of Which Moses Seems to Have Availed Himself in Composing the Book of Genesis' (1753). In this he divides the book of Genesis into two parts, on the ground of the use of Elohim (God) or Yahveh (Jehovah). He holds that these two names for the Deity point to the fact that Genesis was compiled from two parallel, independent documents. His memoir forms the origin of modern criticism on the Pentateuch.

ASTRUP, Eivind, Norwegian explorer: b. Christiania 1870; d. 1896. He was a member of the first and second Peary expeditions, 1891 and 1893, and made the first survey of the northern coast of Melville Bay. He perished while on a snowshoe expedition from Dovre, Norway.

ASTURA, ăs-too'ra, **Italy,** a maritime village 40 miles from Rome. In its little harbor a high tower is said to stand on the site of the villa of Cicero, where Cicero was slain by order of Antony 43 B.C.

ASTURIAS, as-too'rias, **The,** a former principality of Spain. To this mountainous country of the north of Spain the Goths retreated in the 8th century before the sword of the Saracens. The inhabitants of Asturias are said to be less industrious than the Galicians, and less sociable than the Biscayans. The

hereditary Prince of Spain has borne since 1388 the title of Prince of Asturias, or of the Asturians, according to the obsolete division into Asturias de Oviedo and Asturias de Santillana, Oviedo and Santillana being the two chief cities of the principality. Since 1838 the principality has been officially known as the province of Oviedo. See OVIEDO.

ASTY'AGES, the last King of Media, reigned 594–559 B.C. In the latter year he was dethroned by Cyrus, who, according to Herodotus, was his grandson. Cyrus revolted in 559, and defeated Astyages, whom he took prisoner, but afterward appointed governor of Hyrcania.

ASTY'ANAX, sometimes known as Scamandrius. A Greek legendary character, the son of Hector and Andromache.

ASUNCION, ä-soon'the-ōn, or **NUESTRA SEÑORA DE LA ASUNCIÓN** (in English, *Assumption*), the capital of Paraguay, on the river Paraguay. The principal edifices are the cathedral, several other churches and convents, the President's palace, house of Congress, arsenal, National Library, custom-house, a college, hospital, railway station, etc. In the Museum of Fine Arts there are a few old paintings not without interest. The trade of the town is in Paraguay tea, tobacco, fruits, hides, timber, provisions, manufactured goods, very beautiful lace (made by the civilized Indians), excellent hammocks, preserves and sweetmeats. The location of Asunción on a hill above the river favors natural drainage, and to this circumstance is due, in part at least, its established reputation as a healthful place. The dictator Lopez endeavored to give his little capital the appearance of grandeur, and that design was expressed in the larger buildings completed (with a single exception) before the war with Argentina, Brazil and Uruguay (see PARAGUAY — HISTORY). There are through services, by river steamers and rail, with Buenos Aires. Pop. 80,000 in 1916.

ASURNAZIRPAL, ä'soor-nä'zėr-pal, a King of Assyria from 881 B.C. to 860. He was one of the most warlike of Assyrian kings, and in numerous campaigns enlarged his empire, especially toward the westward, extending it from Lebanon to the Tigris. He also rebuilt Calah, his capital, and left a record of his achievements in the so-called 'Standard Inscription.' See ASSYRIA; ASSYRIOLOGY.

ASVALAYANA, also **ACVALYANA,** ancient Hindu author. He is supposed to have written the Srauta-Sutra and the Grhya-Sutra of the Vedas.

ASVIN, or **ACVIN,** two Vedic divinities, Dasra and Nasatya. They were the husbands of Surya, daughter of the sun god, and they brought the light of the sun to the world each morning. They could cure all ills of the flesh and the sickly and the diseased prayed to them for health. Consult Bergaigne, 'La religion védique' (Vol. II, Paris 1878–83); Myriantheus, 'Die Açvins oder arischen Dioskuren' (Munich 1876).

ASWAL, ăs'wāl, a Hindu name of the sloth-bear. See BEARS.

ASYLUM, a place where persons flee for protection. Under the Mosaic dispensation cities of refuge were set apart to which the slayer might flee so that innocent blood should not be shed, in case the person was not worthy of death — that is, in case the act was accidental and not malicious. But among the ancients, outside of the Jews, it seems that temples, statues to the gods, and altars particularly consecrated for such purposes, constituted places of refuge for persons generally, and it was deemed an act of impiety to remove, forcibly, one who had fled to such an asylum for protection. However, Tiberius abolished all asylums except the temples of Juno and Æsculapius. These asylums finally passed over to the Christian world, and under Constantine the Great all Christian churches were made asylums for all those who were pursued by officers of justice or the violence of their enemies, and the younger Theodosius, in the year 431, extended these privileges to all courts, gardens, walks and houses belonging to the Church. In the year 631 the Synod of Toledo extended the limits of asylums 30 paces from every church, and this privilege afterward prevailed in Catholic countries, and it is said to have been a strong armor of defense against the wild spirit of the Middle Ages, and not without good consequences at the time when force often prevailed against justice. But in later times as other and better systems of procedure in the administration of justice became adopted, asylums were abolished in most countries. This seems to have been the origin, nature and object of asylums, and such the common acceptation of the term, but more recently in some countries, the name has been given to institutions for the protection and care of the poor, blind, deaf and dumb and lunatics who are incapable of taking care of themselves.

ASYLUM, Right of. In modern international law the phrase means the privilege extended to foreign legations, whether by the law of nations or by custom, to afford shelter to persons who are subject to the jurisdiction of the states in which the legations are located. Actually no person may *claim* the right of asylum but the legation may *extend* its protection, and thus the modern right differs greatly from the ancient.

Asylum in Legations.— Prior to the middle of the 17th century, diplomatic agents based their claims to the right to grant asylum to fugitives from local authorities on the doctrine of the extraterritoriality of the official residence — that is, the exclusion of the domestic jurisdiction of one state from the precincts of the legation of another state. When a person took refuge within a legation he was considered to be under the protection of the country to which that legation belonged and during his stay to be absolutely exempt from the operation of the domestic laws. The legation officials might surrender him, either at pleasure or through extradition (q.v.) proceedings; but any attempt to capture him or compel his release by force was deemed an invasion of the territory of the state to which the legation belonged. Since the middle of the 17th century the theory of extraterritoriality in this respect has been abandoned and the claim to exercise the right of asylum has been modified greatly. Attempts have been made to justify the right of asylum on the ground of the inviolability of diplomatic agents, but while the legation is still deemed to be exempt from local jurisdiction and an asylum for the diplomatic agent and his

bona fide official and personal household, and while others for a time may gain immunity from arrest by entering a legation, the opinion now prevails that the right of asylum in legations does not apply to visitors or strangers temporarily residing with the agent and still less to fugitives (save perhaps in states where the government is insecure or where frequent revolutions occur) and that fugitives should be surrendered to local officials on demand of the proper authorities. The United States has repeatedly endeavored to secure an international agreement respecting this right but has failed, owing to practices prevailing in states outside of Europe and the United States. The representatives of the Powers often exercised the right in Greece during the revolution of 1862 and in Spain during various periods of anarchy; and as late as 1895 the British Ambassador at Constantinople extended the privilege to the deposed Grand Vizier. In Asia and the South and Central American states there have been numerous instances of granting asylum, but even in these states asylum for other than political offenders is rarely granted and then it is justified by the states exercising it on humane rather than on legal grounds. The United States has discouraged the practice even in this restricted form and has instructed its diplomatic agents to the effect that "The privilege of immunity from local jurisdiction does not embrace the right of asylum for persons outside of a representative's diplomatic or personal household." In some instances the grant of asylum is regulated by treaty, as that of 1856 between the United States and Persia, Article VII of which provides that "The diplomatic agent or consuls of the United States shall not protect secretly or publicly the subjects of the Persian government, and they shall never suffer a departure from the principles here laid down and agreed to by mutual consent." In no case is a minister permitted to offer his dwelling as a resort for refugees and if a fugitive, uninvited, should apply for protection, this should be granted only if his life be in imminent danger from mob violence and only during the continuance of such danger.

Asylum in Consulates.— Under the treaty of 1856 mentioned above no consulate is to be used as a place of asylum for fugitives from local authorities, but other treaties, as that with Italy in 1871, state that such offices "shall never serve as places of asylum." There have been some extreme cases, as in Oriental and South American states, where the consulates have been used as asylums, and in 1903–04, during the Dominican revolution, when political prisoners were threatened with execution, a large number of refugees found asylum in the United States and British consulates. Since consuls are not diplomatic agents they are not by right exempt from local jurisdiction and hence cannot claim the right to extend asylum, but they are sometimes granted immunities, though more as an act of courtesy than as a conceded right.

Asylum on Ships.— In some respects public ships, such as ships of war, are similar to legations, so far as the right of asylum is concerned, since they are generally conceded to be exempt from the local jurisdiction of the ports which they enter; in certain cases the commanders of such ships may extend asylum to refugees, but they are supposed not to abuse the local hospitality by making their vessels places of refuge for offenders against the laws. The navy regulations state: "The right of asylum for political or other refugees has no foundation in international law. In countries, however, where frequent insurrections occur, and constant instability exists, usage sanctions the granting of asylum; but, even in the waters of such countries, officers should refuse all applications for asylum, except when required in the interests of humanity, in extreme or exceptional cases, such as the pursuit of a refugee by a mob. Officers must not directly or indirectly invite refugees to accept asylum." Under modern usage asylum on private ships is not permissible and even though a vessel be in transit criminals aboard such vessels are amenable to local jurisdiction for crimes committed prior to embarkation. Merchant vessels are not exempt from local jurisdiction and cannot claim the right to grant asylum. The right of neutrals to grant asylum to belligerent forces is covered by The Hague Convention of 29 July 1899, articles 57 to 59 of the regulations which relate to the Laws and Customs of War on Land. See ALIENS; EXTRADITION; EXTRATERRITORIALITY; INTERVENTION; NEUTRALITY; REFUGE, CITIES OF; SANCTUARY.

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ASYMMETRIC (as-i-met'rik) **SYSTEM,** in crystallography, the crystal form now more commonly called "triclinic." It was called asymmetric because it has no plane of symmetry. See CRYSTAL.

ASYMPTOTE, ăs'ĭm-tōt (from three Greek words, meaning "not to fall with" or coincide), a term used in geometry to designate a line which continually approaches a curved line, but becomes tangent to it only at an infinite distance. Though the existence of such a line seems paradoxical, it can be demonstrated on the strictest mathematical principles, as in the case of the hyperbola and its directrix. The term first occurs in the conic sections of Apollonius. Asymptotes are of two classes: rectilinear and curvilinear. The latter class includes the spiral, which is also known as a circular asymptote. The equation of the rectilinear asymptote referred to any rectangular axis is

$$y-y''=\frac{dy''}{dx''}(x-x''). \quad (1)$$

in which x'' and y'' denote the co-ordinates of the point of contact, and $\frac{dy''}{dy''}$ the differential coefficient of the ordinate of any point when x'' and y'' are substituted for x and y. The asymptote idea is applied also to surfaces.

AT ODDS, the title of a novel by the Baroness Tautphœus (1863), dealing with the vicissitudes of a Bavarian family during the stormy epoch from Hohenlinden to Wagram. It is told with a happy ease and directness; and if it has not the brilliancy of 'The Initials,' is not less clever as a study of character.

ATA, the people of the Davao district in the island of Mindanao, Philippine Islands. They present the physical characteristics of both the negroid Papuans and the later Malays, from which it is inferred that they are a mixture of both races. This theory is still further borne out by the fact that they do not show any of the homogeneity of a tribe, but are broken up into various isolated groups, some of these groups speaking a dialect only distantly similar to the speech of the rest.

ATACAMA, ä'tä-kä'ma, the name, formerly, of two South American provinces: (1) A northern province of Chile, with an area of more than 29,000 square miles. This was, before the war on the Pacific (see CHILE), the Chilean part of the great Atacama desert region. (2) A Bolivian department, which formerly extended as far north as Peru, and east to Argentina. All that part of the district west of the Andes was ceded, in 1884, to the Chileans, and formed into the department of Antofagasta. The former capital, Cobija, was long the only port in the district; but the rival port of Antofagasta, founded in 1870, rapidly outstripped it (see ANTOFAGASTA). At present the Chilean Atacama is bounded on the north by the province of Antofagasta, by the Argentine Republic on the east, by the province of Coquimbo on the south, and the Pacific Ocean on the west. The area is given as 30,728 square miles. Saltpetre, copper and silver are the most important products of the mines. Capital, Copiapó; best seaport, Caldera. Pop. 65,000 to 66,000.

ATACAMA, a desert region on the west coast of South America, formerly belonging partly to Bolivia, partly to Chile, but now belonging wholly to the latter. It lies between the Andes and the sea and much of it at the height of 3,000 to 5,000 feet above the sea. The surface is diversified with many mountains. The Salina of Atacama, a salt morass, mostly dried up, has a surface of 1,084 square miles, and lies at the height of over 7,000 feet. The best and most recently published description of "the lofty Puna de Atacama," situated between 23° and 26° S. latitude, is in the 'Bulletin of the American Geographical Society' (Vol. XLVI, No. 3).

ATACAMITE, -tak'-, a mineral, originally found as sand in the Atacama province, in northern Chile. It is essentially a hydroxychloride of copper, having the formula $CuCl_2.3Cu(OH)_2$. It crystallizes in the orthorhombic system, and has a hardness of from 3 to 3.5, and a specific gravity of 3.76. Atacamite is green in color, and commonly occurs either massive or in the form of sand. A coating having the same chemical composition is formed on metallic copper, as the result of prolonged exposure to sea-water or air. Atacamite exists in considerable quantity in various parts of South America, and in Australia; and has been used to some extent as a source of copper. In the United States it is found at Jerome, Ariz.

ATAHUALPA (d. 1533), son of the famous Inca Emperor Huayna Capac, of interest chiefly because of his unfortunate career as ruler of Peru. On the death of Atahualpa's father (1525), his half-brother (Huascar) usurped the throne. In the civil war that immediately followed between the followers of the two claimants—a long struggle whose details are not clearly recorded—Atahualpa's faction gained complete victory. The usurper, Huascar, was taken prisoner and confined in the strong fortress of Xauxa. The massacre usual under such circumstances followed, affecting all the royalists who had sided with Huascar. But Atahualpa's reign was proved to be neither long nor happy. Soon after he had been recognized as the rightful ruler of Peru, a Spanish Catholic leader, Pizarro, came to urge upon Atahualpa to embrace the Christian faith and become a vassal of Charles V. This proved to be a mere pretext, however, for wresting the kingdom from the young ruler's hands. Even while these overtures were being made, Pizarro's army had already mustered at Cassamarca, where the Inca then was. Suddenly, without the slightest warning, Pizarro gave the signal for attack. The Peruvians, of course, were absolutely unprepared to withstand this prearranged attack. After hundreds of them had been slain and their king made prisoner, the one-sided onslaught ceased. Atahualpa's release, however, was repeatedly put off, despite his readiness to pay the demanded ransom money. It would seem that Atahualpa, while still in captivity, fostered a counter-attack upon the invaders and also conspired for the assassination of his treacherous half-brother, then in league with the Spaniards. Accounts of his intrigue are neither clear nor very convincing. At any rate, it was on these charges, colored with the accusation of heresy, that Atahualpa, after a mock trial, was condemned to death. He was burned at the stake on 29 Aug. 1533. Consult Prescott's 'History of Peru' and Garcilasso de la Vega's 'Royal Commentaries of the Incas.'

ATALA, the heroine in a romance by Chateaubriand, bearing her name as the title. She is the daughter of an American Indian chief. The braves of her tribe bring into camp a prisoner, the chief of another tribe. She falls in love with him, releases him and flees with him. But having made a vow to her Christian mother that she would never marry, she has no alternative between breaking her vow and leaving her lover. Finally she commits suicide. The romance was first published in the newspaper *Mercure de France* (1801).

ATALANTA, the name of two heroines in Greek mythology. One was a native of Arcadia, celebrated for her skill in archery. She slew with her arrows the Centaurs Rhœcus and Hylæus, sailed to Colchis with the Argonauts, and was present at the chase of the Caledonian boar, which she first wounded; hence Meleager awarded to her the prize. She was renowned for her beauty and swiftness in running. She stipulated that every candidate for her hand should run a race with her, and if he conquered her she was his own, but if he was conquered he was doomed to death at her hand. Many

had fallen victims in the attempt, when Meilanion, by the aid of Aphrodite, overcame her. The goddess gave him three golden apples, which he threw behind him, one after another, as he ran. Atalanta stopped to pick them up and Meilanion reached the goal before her. She accordingly became his wife. The other Atalanta, who cannot very well be distinguished from the preceding, the same stories being told about both, is connected with Bœotia and Bœotian localities. She is said to have been married to Hippomenes. Consult Morris, 'Atalanta's Race.'

ATALANTA IN CALYDON. Swinburne's 'Atalanta in Calydon,' perhaps the greatest, certainly the best known, of his works, is a lyrical drama after the Greek model. Though lacking the severe nobility and restraint of Milton's 'Samson Agonistes,' it is more purely Greek in other respects, and remains the masterpiece of its kind in all modern poetry. Published in 1865, when the poet was 28 years old, it created a literary sensation comparable only to that of 'Childe Harold' and brought to Swinburne a fame almost as sudden and splendid as that of Byron. No English poet has surpassed Swinburne in familiarity with both the spirit and form of Greek literature; and 'Atalanta' reads not like an imitation of some remote and inimitable original, but like the spontaneous utterance of a poet who feels like a Greek, has a Greek story to tell, and inevitably expresses himself in a Greek form. The plot, founded on the story of the hunting of the wild boar of Calydon as told by Homer and later by Ovid, is tragic, simple and replete with all the elements of passion, and is handled with superb skill, from the first entrance of the mother Althea, with her foreboding of woe, to the final dirge over her dying son Meleager. The blank verse of the recitative abounds with subtle and varied harmonies unsurpassed in modern English poetry. The choral passages, while perhaps more intimately related to the action than those of Euripides, are less so than those of Æschylus and Sophocles. Eulogy has exhausted itself over the lyrical power and splendor of the choruses in Atalanta, which surpass even Shelley in vehemence and richness and which added new resources to English verse. The irresistible melody of such lyrics as "When the hounds of spring are on winter's traces," "Before the beginning of years," "We have seen thee, O Love, thou art fair," show what music our language may become in the hands of a master. It is doubtful if any single work ancient or modern offers a greater variety of metrical effects. What may be termed the theology of 'Atalanta,' with its bitter arraignment of fate and its hatred of the gods, is scarcely classic, though here and there such a note is sounded by Euripides. Swinburne has here injected into the drama something of his own pessimism and his rebellion against established beliefs. Again, while the story, the form, the general sentiment and many of the details of 'Atalanta' are purely Greek, the style, incomparably splendid as it is, lacks on the whole the conciseness and restraint of Greek tragedy. However, such faults, if faults they be, are negligible in a work which stands as one of the most remarkable achievements of modern poetry. Consult Gosse, 'Life of Swinburne,' (ch. 4); Wratislaw, Theodore, 'Algernon Charles Swinburne, Study'; Thomas, Edward, 'Algernon Charles Swinburne, Critical Study'; Pound, Olivia, 'On the Application of the Principles of Greek Lyric Tragedy in the Classic Dramas of Swinburne' (University of Nebraska Studies, Vol. XIII).

MARION TUCKER.

ATAMAN, the title of the chief of the Cossack tribes. See HETMAN.

ATARGATIS, a Syrian deity referred to in the Apocrypha. She is generally described as the "fish goddess." The name is derived by compounding two divine names: the first part being a form of the Himyaritic "Athtar," the equivalent of the Old Testament "Ashtoreth," and the Phœnician "Astarte," with the feminine ending omitted; and the second is a Palmyrene name "Athe" (i.e., *tempus opportunum*) which occurs as part of many compounds. This similarity of the first syllable has led to the confusion of the goddess with Astarte. The origin of both deities is probably the same. A plausible hypothesis is that after the political extinction of the Semites and the consequent deterioration of the cult of Astarte, it was found necessary to perpetuate some of the leading features of such a widespread and deep-rooted cult. The fertility and life-giving power of water was one of the most familiar of the conceptions of the world of thought and fancy of which Astarte was the centre, the idea being in a large measure suggested by the mysterious origin and fecundity of fish. These consequently figure very largely among other elements in the cult of Atargatis which replaced but did not supersede the worship of Astarte. Atargatis had a temple at Carnion in Gilead (1 Macc. v, 24, and 2 Macc. xii, 26, but the proper home of the goddess was not Palestine but Syria, at Hierapolis where she had a great temple and a large following. From Syria her worship extended to Greece, Italy, Sicily and even to the farthest northern limits of the Roman empire, carried no doubt by the Syrian merchants, slaves and mercenary troops. The legends concerning her origin are numerous and of an astrological character, intended to account for the Syrian dove-worship and abstinence from fish. According to the story in Athenæus VIII, 37, she is derived from *ἀτερ Γάτιδος*, (without Gatis), a queen who is said to have forbidden the eating of fish. Diodurus Siculus tells how she fell in love with a youth who was worshipping at the shrine of Aphrodite, and by him became the mother of Semiramis, the Assyrian Queen, and how in shame she flung herself into a pool at Ascalon and was changed into a fish. In another story she was hatched from an egg, found by some fish in the Euphrates and by them pushed ashore, where it was hatched by a dove. Out of gratitude she persuaded Jupiter to transfer the fish to the Zodiac (cf. Ovid, Fast. II, 459–474; Metam V, 331). The source of the Chaboras River was worshipped also as the place where Atargatis bathed after her marriage with Hadad (Baal). It was said that the waters gave out a sweet odor and were full of sacred fishes. Together with Hadad, she is the protecting deity of the community, wearing a mural crown. She is the ancestor of the royal house, the founder of social and religious life, the goddess of generation and fertility (hence the prevalence of

phallic emblems) and the inventor of useful appliances. Not unnaturally she is identified with the Greek Aphrodite. By a conjunction of these many functions, she becomes ultimately a great Nature goddess, analogous to Cybele and Rhea; in one aspect she typifies the function of water in producing life; in another, the universal mother-earth (Macrobius, Saturn 1, 23); in a third, the power of destiny. Consult articles in Herzog-Hauck, 'Realencyklopädie' (1897); Robertson-Smith, 'Religion of the Semites' (2d ed., pp. 172–75, London 1914) and in the *English Historical Review*, 1887; Pietschmann, 'Geschichte der Phönizier' (1889).

ATAULFUS, ATAULF, or **ADOLF,** King of the Visigoths. The date of his birth is unknown. He was the brother-in-law of Alaric, whom he assisted in the sieges of Rome. After Alarc's death he went to Gaul and married Galla Placidia, sister of the emperor, June 414. In the same year he went to Spain and was assassinated at Barcelona in 415.

ATAVISM (Latin *atavus;* originally "ancestor," later specialized as "great-great-great-grandfather"); in biology, the reappearance in an organic being of specific ancestral peculiarities which have not appeared in intermediate generations, or of peculiarities of ancestral side branches not represented in the direct line. It is often loosely used as synonymous with reversion, but in scientific usage the latter is not the reappearance of single characteristics, and certainly not of abnormal ones, but the return in general type to the primitive type from which the special race was evolved. In this sense, it may be said that reversion is the extreme backward limit of atavism. For example, the birth of a six-fingered child with a six-fingered grandfather or uncle but normal parents would be atavism; but the approach of human beings left on a desert island to the prognathous and hairy type of the simians, were it conceivable, would be reversion. Sometimes the two are hardly to be discriminated; thus, the appearance of a tail-bone or pointed ears would be an atavism recalling the primitive type, as are horses with toes, yet not quite a reversion. A true reversion is the banded pigeon which is a frequent "sport" among fancy breeds; and the still commoner mongrel "yellow dog," a reversion to the jackal type. Atavisms are part of the perpetual family wonders, the reproduction of minute special features, habits, tricks of behavior, even tastes and fashions of speech, characteristic of distant relatives or far-back ancestors, but perhaps obliterated for long periods. In sociology, especially criminology, the word is used precisely in the sense of reversion to primitive instincts and passions, supposed to be overlaid or suppressed by civilization. The criminal on this theory is a being who has lost his evolved characteristics, and gone backward to the primitive savage. This, however, has too many flaws to be scientifically acceptable.

ATAXIA, an irregularity of function, but the term is usually applied to incoordination of muscular movements. It is a phenomenon seen in many disordered states of the body and not confined to the one disease, locomotor ataxia. Thus, ataxia is a common symptom of alcoholic intoxication. Two forms of ataxia may be distinguished, static and motor. In static ataxia there is an irregularity in the maintenance of attitudes and positions. This form of ataxia is common in chronic cocaine poisoning and is present in some severe cases of chorea, or Saint Vitus' dance. The patients' limbs seem to give way beneath them and there is a restless irregularity in attitude and pose. Static ataxia is also a symptom in certain types of insanity, notably the disease termed catatonia. Motor ataxia is a much commoner form of this condition. In alcoholic intoxication it is well developed and the loss of control, largely due to diminution of the function of the sensory nerves, is too well known to need description. In a number of diseases of the nervous system ataxia of the muscles of the arms, lips, tongue, trunk and lower limbs is a prominent symptom. Ataxia is to be distinguished from loss of the sense of equilibrium. See CEREBELLUM; COORDINATION; EQUILIBRIUM; HEMIPLEGIA; LOCOMOTOR ATAXIA; SCLEROSIS.

ATBARA, ȧt-bä'rą (*Bahr-el-Agwad,* or Black River), an important tributary of the Nile. It rises in Abyssinia to the northwest of Lake Tzana, flows to the north, receiving several large tributaries, especially the Mareb and Tacazzé, and enters the Nile lat. 17° N. Here Lord Kitchener defeated the Mahdists 8 April 1898.

ATCHAFALAYA, ăch'ă-fa-lī'ya, a river in Louisiana, an outlet of the Red River. It flows southward through Grand Lake, and enters the Gulf of Mexico by Atchafalaya Bay. Its length is estimated at 250 miles and it is supposed to have been formerly the principal channel of the Red River.

ATCHEEN, a province of the Dutch Indies, until 1873 an independent state in the northwest part of Sumatra. Area 20,544 square miles, and containing a population of over 500,000. See ACHIN.

ATCHISON, David Rice, American legislator: b. Frogtown, Ky., 11 Aug. 1807; d. 26 June 1886. He was educated for the bar, and began practising in Missouri, in 1830. He was elected to the legislature in 1834 and 1838; was appointed judge of the Platt County Circuit Court, and, in 1843, while holding this office, was appointed United States senator to fill a vacancy. He was twice elected to the last office, and during several sessions was president pro tempore of the Senate. During Sunday 4 March 1849, he was the legal President of the United States, as General Taylor, the President-elect, was not sworn into office until the following day. Senator Atchison became conspicuous in the slavery debates and in the Kansas-Nebraska struggle, because of his strong pro-slavery views. The city of Atchison, Kan., was named after him.

ATCHISON, Kan., city and county-seat of Atchison County, on the Missouri River, 20 miles above Fort Leavenworth, and on the Atchison, Topeka and Santa Fé, the Chicago, Rock Island and Pacific, the Burlington and Quincy and other railroads. The city is beautifully situated on the "Great Bend" of the Missouri River, and because of its excellent river and extensive railroad facilities it is an important commercial centre, and one of the principal cities of the State. It exports large quantities of grain, flour, livestock, coal, lumber, fruit and general agricultural produce. The whole-

sale trade of the city in groceries, drugs, hardware, etc., is also very extensive, representing annually more than $50,000,000. The manufacturing interests of Atchison are important, there being over 50 large industrial establishments, including grain elevators, flouring-mills, foundries, railroad shops, carriage works, brick yards, furniture, broom and harness factories, etc. The United States census of 1914 recorded 60 manufacturing establishments of factory grade, employing 859 persons, of whom 684 are wage earners, receiving $403,000 annually in wages. The capital invested aggregates $2,073,000, and the value of the year's output was $3,899,000. The city contains many attractive buildings, notably the county courthouse and government building, and the union depot erected at a cost of $140,000. The Missouri River is bridged by a noteworthy structure some 1,200 feet long. There are three parks in the city — Forest, City and Central; three banks with a combined capital of $300,000 and an annual business of $7,000,000; daily, weekly and monthly periodicals, and gas, electric-light, sewer, water and electric railway plants. Atchison is the seat of the State Soldiers' Orphans' Home; Wells' Insane Asylum; Allaman's Hospital; Midland College (Lutheran); Saint Benedict's College (Roman Catholic); Mount Saint Scholastica's Academy (Roman Catholic); has a fine public library and an excellent system of public education (8 public and 3 parish schools). The school board is chosen by popular vote. The city is governed by a mayor elected every two years, and a municipal council of 10 members. The mayor appoints the administrative officials who are subject to confirmation by the city council. The city was first settled in 1854 and was named in honor of Senator D. R. Atchison. It was incorporated as a city in 1859. Pop. (1910) 16,429; (1914) 17,000.

ATCHISON, TOPEKA & SANTA FÉ RAILWAY, The, one of the most important railways in the United States, and including a long list of auxiliary companies. The charter was granted 3 March 1863, the route prescribed being from Atchison on the Missouri River to the western boundary of the State of Kansas, in the direction of Santa Fé, N. Mex., a distance estimated at 500 miles. The time for completion was limited to 10 years, which expired 3 March 1873. Five years and six months were allowed to pass without commencing operations. In September 1868 the charter was transferred to new parties. In 1869, 28 miles were built; in 1870, 34 miles; in 1871, 75 miles. The western boundary of Kansas not having been established, it was estimated that the remainder to be built, with only one year for the completion of the road and telegraph line which was to accompany it, was 345 miles. By great effort the means were provided, and the work completed with rapidity then unprecedented, and the cars were run over the entire line from the Missouri River to Colorado, about 470 miles, on 28 Dec. 1872, thereby saving the land grant, which would have been forfeited had the road not been completed before 3 March 1873. The road was remarkably well built, much better than the majority of western railways at that time, and in general construction bore comparison with the best roads either east or west. It ran for the greater part in the valley of the Arkansas River, with easy grades and curves, and almost immediately developed an amount of business that surprised the ownership and the public. The part which this railway has had in the building up of Kansas, Colorado and other sections through which it runs cannot be overestimated. It opened vast tracts of productive land to settlement, and drew a large emigration from the East to that region, where thriving towns and fertile farms took the place of what had been a desert. The road acquired a large share of through business in 1876 by leasing the Pueblo & Arkansas Valley and the Kansas City, Topeka & Western. Steel rails were adopted in place of iron, and neither effort nor expense were spared to bring the road up to the highest standard.

The growth of the Atchison, Topeka & Santa Fé in 40 years is shown by recent statistics. In 1875 the gross earnings of the system were $1,500,000, operating expenses $700,000; and net earnings $800,000; in 1917 the gross earnings were $156,179,120; operating expenses $96,333,568; and net earnings $51,321,917. The growth of mileage has been equally rapid. In 1875 the road only extended from Kansas City and Atchison to Wichita and Pueblo, 711 miles. On 30 June 1902 the main track mileage operated was about 7,900. On 30 June 1917 it had increased to 11,261.98 miles, the difference representing new lines. The rolling stock, about 38 years ago, consisted of 38 locomotives and 1,028 cars, including two Pullmans. By recent figures (30 June 1915) it was 2,105 locomotives and 72,748 cars. Locomotive repairs were $60,000 in the early period, and $7,639,717.69 in the present. Grain shipments in 1875 were 28,400 tons, and were by later figures 2,862,382 tons. Live stock jumped from 87,500 head to 1,200,420 head. Passenger and freight figures showed proportionate increase. These figures give an idea not only of the growth of the Atchison, Topeka & Santa Fé system, but also of the strides made by the western United States in the past 40 years.

In one of the reports of the Atchison, Topeka & Santa Fé Railway Company, President Edward P. Ripley said:

"The large increase in the system earnings reflects the rapid growth of the territory served by your lines in population and wealth, and this growth is likely to continue. Many miles of your main lines are fed by but few branches and extensive territory that should furnish profitable traffic to the system still remains, in a great measure, undeveloped for want of adequate railroad facilities. The construction of additional branches and feeders will be desirable in the near future, in order to increase the earnings of the system and strengthen its position, and in order to furnish additional transportation facilities to the growing territory through which the system extends. Furthermore, the traffic on your main lines has become so dense that the construction of second tracks and provision for additional equipment will soon be imperative. Since the year 1896 more than $30,000,000 of surplus net income has been applied to the development and enlargement of your properties, and it is expected that a considerable amount of surplus net income will be applied in like manner hereafter; but it is the opinion of your directors that additional capital should be obtained during the next few years

for the purposes above referred to, and it is believed that the expenditure of this capital will result in a substantial increase of the surplus net income of the company.»

In the fiscal year 1916–17 the company's operating expenses consisted of $19,119,336 for maintenance of way, $25,273,168 for equipment, $2,780,823 for traffic, $45,910,504 for transportation, and $3,494,122 for general expenses.

ATE, ā'te, among the Greeks the goddess of hate, injustice, crime and retribution. According to Homer she was the daughter of Zeus, but according to Hesiod, the daughter of Eris (Strife). She was a vengeful goddess and was banished from Olympus by Zeus, whom she had induced to take an oath of which he subsequently repented. Her influence was always pernicious, and in her journeyings over the earth she afflicted mankind, but she was followed by other goddesses, the benevolent daughters of Zeus, who restored those who had come under Ate's evil influence.

ATELES, a genus of South American monkeys of the division with long prehensile tails, to which the name Sapajou is sometimes collectively applied. The head is round, and the facial angle about 60 degrees; the limbs are remarkably long and slender, upon which account the English name of spider monkey is sometimes used as a generic designation; the forelimbs are either destitute of a thumb or have a rudimentary one.

ATELESTITE, a native basic arsenate of bismuth, having the formula $3Bi_2O_3.As_2O_5.2H_2O$. It is yellow in color, and translucent with an adamantine lustre. It occurs in small monoclinic crystals, at Schneeberg, Saxony.

ATELIERS NATIONAUX, ą-tĕ-lĭā' nąsyō'nō', national workshops established by the provisional government of France in 1848. Previous to the outbreak of the revolution of February 1848, there had been two years of scarcity, inundations and commercial crisis. *Ateliers nationaux,* or national workshops, were opened at once. The workmen were organized under lieutenants and brigadiers of their election. The number of applicants including arrivals from the provinces at length exceeded 100,000 and the total expense reached nearly 16,000,000 francs. The men were employed on roads, railways, earthworks, etc., but it was impossible to find work for the whole, and a great part of the labor was unprofitable. There were besides 30,000 to 40,000 women employed in preparing articles of outfit for the army, whose work left only a trifling loss. In June the Constituent Assembly resolved upon the immediate closing of the ateliers. This rash step provoked the insurrection of the Red Republicans (23–26 June), suppressed by General Cavaignac with fearful slaughter. In Lyons the ateliers were closed without disturbance, but in some other towns trouble was occasioned.

ATELLANÆ FABULÆ (called also *Oscan plays*), a kind of light interlude between tragedy and comedy, performed by freeborn young Romans. This kind of a play is said to have originated in *Atella,* a city of the Oscans, between Capua and Naples, and a few disconnected fragments are all that remain of a national Italian comedy, consisting of farce seasoned by satire.

ATESHGA (the place of fire), a place much revered by Persian fire-worshippers. It is on the peninsula of Apsheron, on the west coast of the Caspian, and is visited by large numbers of pilgrims, who bow before the sacred flames issuing from the bituminous soil.

ATH, āt, town of Belgium, 14 miles from Mons. It has a hospital and college and important manufactures of linen, lace, cutlery, soap and large hammers. It was formerly a fortress. Pop. at outbreak of European War about 12,000.

ATHA, a false prophet in the reign of the Caliph Mehedy, or his predecessor, Almansur. He taught the doctrine of metempsychosis, and claimed to be an incarnation of divinity. He had lost one of his eyes, on account of which he always wore a veil, whence he received the epithet of Mokanna. He is the hero of Moore's «Veiled Prophet of Khorassan» in 'Lalla Rookh.'

ATHABASCA, ăth'a-băs'ka, formerly a district in northwestern Canada formed in 1882 and enlarged in 1895. On 1 Sept. 1905 the province was divided, the westerly portion being united to Alberta (q.v.), and the easterly portion combined with Saskatchewan and Assiniboia to form the province of Saskatchewan (q.v.).

ATHABASCA, (1) the name of a river in northwestern Canada which has its source in the eastern slopes of the Rocky Mountains, near Mount Brown, pursues a tortuous course to the north till it falls into Lake Athabasca. (2) The name of a Canadian lake, in the northwest territories, also called Lake of the Hills, 230 miles in length and averaging 14 miles in width. Near its southwestern extremity it receives the Athabasca River and discharges its waters northward by the Great Slave River. The north shore is high and rocky and thickly wooded with firs and poplars, etc., the south shore is level.

ATHABASCA PASS, a narrow passage in the Canadian Rocky Mountains, between Mount Brown and Mount Hooker. It crosses the boundary between the district of Alberta and British Columbia.

ATHALARIC, a king of the Ostrogoths: b. 516; d. 534. He was the grandson of Theodoric the Great and succeeded him on the throne, but died at the early age of 18 from dissipation.

ATHALIAH, the daughter of Ahab, King of Israel, and wife of Joram, King of Judah. She was a woman of abandoned character, and fond of power, who, after the death of her son Ahaziah, opened her way to the throne by the murder of 42 princes of the royal blood. She reigned six years; in the seventh the high priest Jehoiada placed Joash, the young son of Ahaziah, on the throne of his father. Athaliah, attracted by the noise of the people who were crowding to the coronation of Joash, entered with them into the temple, where the ceremony was going on. At the sight of the new king, surrounded by priests, Levites, great officers of the kingdom, and the joyful people, she was beside herself; she tore her hair, and cried out, «Treason!» Jehoiada ordered her to be immediately led from the temple by the officers, and commanded that all who should offer to defend

her should be slain; but she was put to death at the gate of the palace without opposition. The altars of Baal, which she had erected, were thrown down, and the worship of God restored (about 877 B.C.) (2 Kings viii, ix). This story is the theme of Racine's 'Athalie,' written at the request of Madame de Maintenon.

ATHALIE. This drama by Racine was called by Voltaire "the masterpiece of the human intellect" and by Boileau Racine's "most beautiful work." Most modern critics would accord it at least the second place among his dramas. But it was slow in winning general recognition. After his 'Esther' had been produced with much éclat in 1689 by the aristocratic young ladies of Madame de Maintenon's foundation at Saint Cyr, Louis XIV ordered the poet to compose for the same amateur stage a new tragedy drawn also from the Scriptures. Two years later 'Athalie' was ready, but Madame de Maintenon had conceived scruples as to the disturbing effect of dramatic representations on her educational wards. It was accorded only a chamber performance without costumes in 1691, and passed almost unnoticed. Had the express will of king and author been followed, the French stage would have been permanently deprived of a great masterpiece. It was first presented to the theatre-going public 3 March 1716. The subject of the play is the revolt of the loyalist priesthood under Jehoiada against the usurping Queen Athaliah, the anointing of the Child-King Jehoash, the destruction of the temple of Baal, the slaying of his priest Mathan and finally of Athaliah as told in 2 Kings xi, supplemented by the account in 2 Chronicles, xxii and xxiii. In the poet's hands this rather crude account of dynastic rivalries and sacerdotal ambition has become a splendid picture of religious enthusiasm, a superb plea for the divinity that was supposed to hedge true royal blood as well at the court of Versailles as in Jerusalem. Racine's 'Athalie' is a grandly tragic portrayal of a commanding woman who knows no law but the feverish pursuit of the objects of her inconsequent passion. Prone to superstition, she struggles wildly with the portents of her fears, dashing herself against righteous fate to ruin. Joab, the high priest, is the type of a pitiless fanatic, disinterested personally but unscrupulous by conviction. Abner is the simple soldier, Mathan the ambitious priest who seeks to make a stepping stone of religion, Nabal the selfish zealot, Joas one of the very few genially conceived children of the stage. To a chorus of Levite girls the poet has given several canticles, yielding little to those of 'Esther' in devout beauty. There are translations of the play by R. B. Boswell and others.

BENJAMIN W. WELLS.

ATHAMAS, the son of Æolus, and husband of Nephelē, the cloud goddess. Their children were Hellē and Phryxus. Being afterward separated from Nephelē, he had by Ino, his second wife, Learchus, Melicertes and Eurycleia. Athamas, having lost his reason through the anger of Hera, and taking Ino and her children for a lioness and her whelps, seized Learchus and dashed him against a stone; while Ino, with Melicertes in her arms, plunged into the sea, and became the sea goddess Leucothea, Melicertes being transformed into Palænon, a divinity worshipped by sailors. Athamas now abandoned Bœotia and fled to Phthiotis, where he built Alos, and united himself with Themisto.

ATHAN'AGILD, the 14th king of the Spanish Visigoths, who succeeded Agila in 554, and died in 566. Being threatened by Agila, he applied for aid to Justinian, Emperor of the East, who sent troops, and Athanagild defeated his adversary, who was obliged to retire to Merida. Athanagild was re-established at Toledo, which he made his capital.

ATHAN'ARIC, a king of the Visigoths in Thrace about the middle of the 4th century: d. Constantinople, 25 Jan. 381. The Emperor Valens made war upon him and compelled him to sue for peace, but Athanaric would not come upon the Roman territory to sign the treaty, while Valens thought it beneath his dignity to visit the barbarian at home. Accordingly a bridge of boats was constructed across the Danube, and the two potentates met in the middle. In 380 he was compelled to flee to Constantinople, where Theodosius received him hospitably, and gave him a small pension until his death. Consult Hodgkin, 'Italy and Her Invaders' (Vol. I, 1880).

ATHANASIAN (ăth'ą-nā'zhăn) **CREED.** See CREED.

ATHANASIUS, ăth'ą-nā'zhĭ-ŭs, **Saint,** bishop of Alexandria, a celebrated Greek theologian: b. Alexandria about 296; d. 373. He had a Christian education, and came into the family of Alexander, afterward archbishop of Alexandria. Alexander took him to the council at Nice, where he gained the highest esteem of the fathers by the talents he displayed in the Arian controversy. About 326 he became bishop of Alexandria. The complaints and accusations of his enemies at length induced the Emperor Constantine to summon him in 334 before the councils of Tyre and Jerusalem, but his judges could do nothing, however, further than suspend him from his office. He still continued in the discharge of his duties until the Emperor, deceived by new falsehoods, banished him to Treves. The death of Constantine put an end to this banishment at the end of a year and some months. Constantius, Emperor of the East, recalled the holy patriarch. His return to Alexandria resembled a triumph. The Arians made new complaints against him, and he was condemned by 90 Arian bishops assembled at Antioch, while 100 orthodox bishops, assembled at Alexandria, declared him innocent. Pope Julius confirmed this sentence, in conjunction with more than 300 bishops assembled at Sardis from the east and west, and in consequence of this he returned a second time to his diocese. But when Constans, Emperor of the West, died, and Constantius became master of the whole empire, the Arians ventured to rise up against Athanasius. Athanasius, displaced for a third time, fled into the deserts of Egypt. His enemies pursued him even here, and set a price on his head. To relieve the hermits who dwelt in these solitary places, and who would not betray his retreat, from suffering on his account, he went into those parts of the desert which were entirely uninhabited. He was followed by a faithful servant, who, at the risk of his life supplied him with the means of subsistence. In this undisturbed spot Athanasius composed many writings, full of

eloquence, to strengthen the faith of the believers, or expose the falsehood of his enemies. When Julian the Apostate ascended the throne he allowed the orthodox bishops to return to their churches. Athanasius therefore returned after an absence of six years. The mildness which he exercised toward his enemies was imitated in Gaul, Spain, Italy and Greece, and restored peace to the Church. But this peace was interrupted by the complaints of the heathen, whose temples the zeal of Athanasius kept always empty. They excited the Emperor against him, and he was obliged to flee to Thebais to save his life. The death of the Emperor and the accession of Jovian again brought him back; but Valens becoming Emperor eight months after, and the Arians recovering the superiority, he was once more compelled to flee. He concealed himself four months, until Valens, moved by the pressing entreaties and threats of the Alexandrians, allowed him to return. From this period he remained undisturbed in his office until he died, 373. Of the 46 years of his official life he spent 20 in banishment, and the greater part of the remainder in defending the Nicene Creed. Athanasius is one of the greatest men of whom the Church can boast. His deep mind, his noble heart, his invincible courage, his living faith, his unbounded benevolence, sincere humility, lofty eloquence, and strictly virtuous life, gained the honor and love of all. His voluminous writings, which are chiefly controversial and dogmatical, treat of the mysterious doctrines of the Trinity, the incarnation of Christ and the divinity of the Holy Spirit. His 'Apology Against the Arians,' addressed to the Emperor Constantine, is a masterpiece. The creed which goes under his name was not written by him, but belongs to a later time (see CREED). The most complete edition of his works is that published at Padua in 1777 (4 vols. folio).

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ATHAPASCAN STOCK (also *Tinneh*), of American Indians, and one of their most numerous and widely distributed linguistic and ethnological groups. The type-name is taken from a northwest Canadian group, the western Montagnais; but the tribes are scattered from Alaska to Mexico. The original stock were semi-arctic, along the Yukon and Mackenzie, fierce and energetic, but of a low type of culture; and spread southward by conquest on both sides of the Rocky Mountains. They are divided into three chief groups, the northern, the Pacific and the southern. The first are those in the original home,— northwest Canada and interior Alaska,— Montagnais, Montagnards, Chippewayan, Kutchin, etc. These number about 8,500. The second are those of Washington, Oregon and California, except the Thlinkeet coast tribes which extend along the Alaskan coast also. These are few and scattered tribes, about 900 souls in all. The southern, and far the most important, comprises some 23,500, mostly of the great Apache and Navajo confederacies, also the Jicarillas and Mescaleros, and the Lipan, of Mexico.

ATHARVANA, ạt'hār'vạnạ, the fourth of the Indian Vedas. Its language is more modern than that of the other three. The theological treatises, regarded as 52 in number, called Upanishads, are appended to the Atharvan Veda.

ATHEISM, the denial of the existence of a God. Among the Greeks atheism consisted in a denial or non-recognition of the gods of the state. Socrates was put to death for asserting the superiority of the divine wisdom to the other gods as the ruler and disposer of the universe thus contradicting Greek mythology, which assigned that office to Zeus. In Latin times atheism still continued to be a negation, with no pretension to rank as a system. It was closely akin to that cultured unbelief which extensively prevailed among the Humanists during the early part of the Renaissance. The atheism of the 18th century was a protest against current religious hypocrisy; and, like its predecessors, put forward little or nothing to replace the system it attempted to destroy. The atheism of the 19th century may be taken to include every philosophic system which rejects the notion of a personal Creator; in this sense it ranks as a genus, of which Atomism, Pantheism, Positivism, etc., are species. Strictly it is the doctrine that sees in matter the sole principle of the universe. Popularly, atheism consists in the denial of a God; this view is probably founded on the mistranslation of Psalms xiv, 1, and liii, 1, which should be, "The fool hath said in his heart, No God for me," that is, he strenuously rejects the traditional God of established religions. Among well-known modern atheists figure Voltaire, Thomas Paine, J. Holzoake, Charles Bradlaugh and Robert G. Ingersoll. Consult Ainslie, R., 'Is there a God?' (London 1840); Beecher, L., 'Lectures on Scepticism' (Cincinnati 1835); Belot, G., 'L'idée de Dieu et l'athéisme' (Paris 1913); Bentley, R., 'The Folly of Atheism' (London 1836-38); Braden, C., 'The Problem of Problems and Its Various Solutions, or Atheism, Darwinism, and Theism' (Cincinnati 1877); Browne, W. R., 'The Present Aspect of the Conflict with Atheism' (London 1883); Carret, J., 'Demonstration de l'inexistence de Dieu' (Paris 1912); Cilleuls, A. de, 'Germes et fruits de l'athéisme social' (Paris 1900); Crusus, T. T., 'The Origins of Atheism' (London 1684); Du Bois, H. A., 'The Scientific Atheism of the Darwinian School of Evolutionists' (New York 1880); Dwight T., 'The Nature and Danger of Infidel Philosophy' (New Haven 1798); Gentili, R., 'L' Atheisme refuté par la science' (Paris 1869); Gibbon, J. M., 'Atheism and Faith' (London 1904); Kerby, W. J. 'Atheism and Socialism'

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ATHEL, or **ÆTHEL,** an Old English word signifying noble, eminent, not only in blood or by descent, but in mind. It is frequently a part of Anglo-Saxon proper names.

ATHELING, a title of honor among the Anglo-Saxons, meaning one who is of noble blood. The title was gradually confined to princes of the blood royal, and in the 9th and 10th centuries applied exclusively to the sons or brothers of the reigning king. It was first conferred on Edgar by Edward the Confessor, his granduncle, who bestowed it when he designed to make him successor to himself.

ATHELNEY, ăth'ĕl-nĭ, a marshy island in Somersetshire, England, about seven miles southeast of Bridgewater. It is formed by the junction of the rivers Parret and Tone. Alfred the Great established a fortified post here during a Danish invasion, and afterward founded an abbey which has entirely vanished.

ATHELSTAN, a Saxon monarch, the first to assume the title of King of England. He succeeded his father, Edward the Elder, in 925, and died in Gloucester, 27 Oct. 940. He was victorious in his wars with the Danes of Northumberland, and the Scots, by whom they were assisted. After the overthrow of his enemies at Brunanburh (937), which became famous in Saxon song, he governed in peace and with great ability.

ATHENÆUM, the general name of temples to Athena, but more especially applied to the temple at Athens, frequented by poets, learned men and orators. Instruction was also given there to the youth, and in later times the name was applied to all places of education for the young. The same name was given at Rome to the celebrated school which Hadrian established on the Capitoline Mount about 135 A.D. Many learned men received ample salaries for giving instruction in this institution, and that they might be enabled to study at leisure. Here also learned men assembled to exchange ideas.

ATHENÆUS, Greek rhetorician and grammarian: b. Naucratis, lived first in Egypt, then at Alexandria, and afterward at Rome, at the end of the 2d and beginning of the 3d century after Christ. He has left an encyclopedic work in the form of conversation, called the 'Feast of the Learned' (Deipnosophistæ), a rich but ill-arranged treasury of historical, antiquarian, philosophical, grammatical and other knowledge. The principal editions are those of Schweighäuser (1801–07); Dindorf (1827); Meineke (1859–67) and was translated by Yonge in 'Bohn's Classical Library' (1854).

ATHENAGORAS, Christian philosopher of Athens, who wrote in Greek an 'Apology for the Christians,' addressed to the Emperor Marcus Aurelius, in 177. This work defends the Christians from the accusations brought against them by the heathens (of atheism, of incest, of eating murdered children and the like), with a philosophical spirit and in a lively and forcible style.

ATH'ENA'IS, or **EUDOCIA,** Empress of the East, daughter of the Athenian philosopher Leontius: b. Athens about 393–94 A.D.; d. Jerusalem about 465. Athenais gaining the favor of Pulcheria, sister of the Emperor Theodosius, a youth of 20 years of age, presently became the wife of Theodosius and was persuaded to receive baptism by the name of Eudocia. By Theodosius she had a daughter, Eudoxia, who was married to Valentinian III, Emperor of the West. She was indisposed to submit to the authority of Pulcheria, who virtually ruled the empire of the East, and a quarrel ensued, in which Eudocia had for a time the ascendency; but the jealousy of her husband being aroused, the authority of Pulcheria was restored, and Eudocia was permitted to retire to Jerusalem. When her daughter and granddaughters were taken prisoners by Genseric she became reconciled to the orthodox Church.

ATHENE, ą-thē'nę. See MINERVA.

ATHENE, Temple of. See ÆGINA.

ATHENE PARTHENOS (Athene the Virgin), a copy of the statue of Athene by Phidias, but much inferior to it, now in possession of the National Museum at Athens.

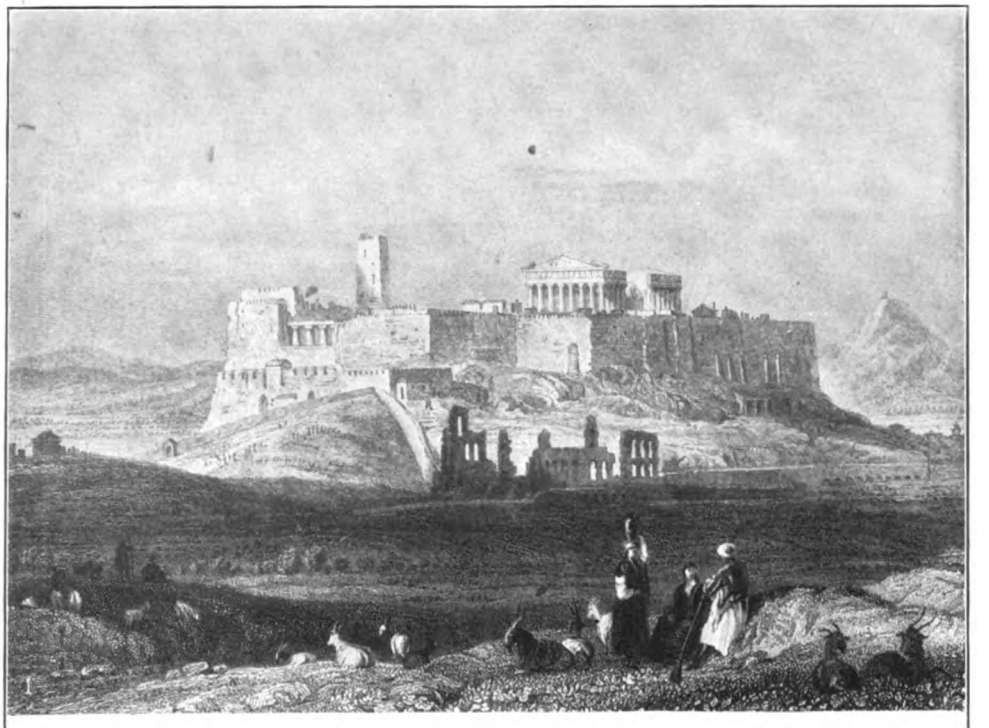
ATHEN'ODO'RUS, the name of several noted men of ancient Greece. (1) Anthenodorus of Tarsus, surnamed Cananites, son of Sandon: b. Tarsus 74 B.C.; d. 8 A.D. He was a philosopher of the school of the Stoics and the teacher of the Roman Emperor Augustus when the latter was a boy. On becoming emperor Augustus sent for him and made him the teacher of young Tiberius. Strabo refers to him as a man of profound learning. He was also on friendly terms with Cicero. His influence with the Emperor was strong, but he did not exercise it to any great extent, beyond allowing himself a wide latitude in the matter of free speech. It is said that he advised the Emperor to repeat the alphabet to himself whenever he felt offended. A few years before his death he returned to his native Tarsus. (2) A sculptor of the Rhodian school who, in collaboration with Agesander and Polydoros, executed that remarkable group, the Laocoön, and who lived during the 1st century B.C. (3) A Stoic philosopher: b. Tarsus 110 B.C.; d. 40 B.C. He was chief of the library at Pergamum, where he attempted to revise the whole literature of the Stoics by cutting out of the writings of all of its writers passages with which he did not agree. Later in life he removed to Rome.

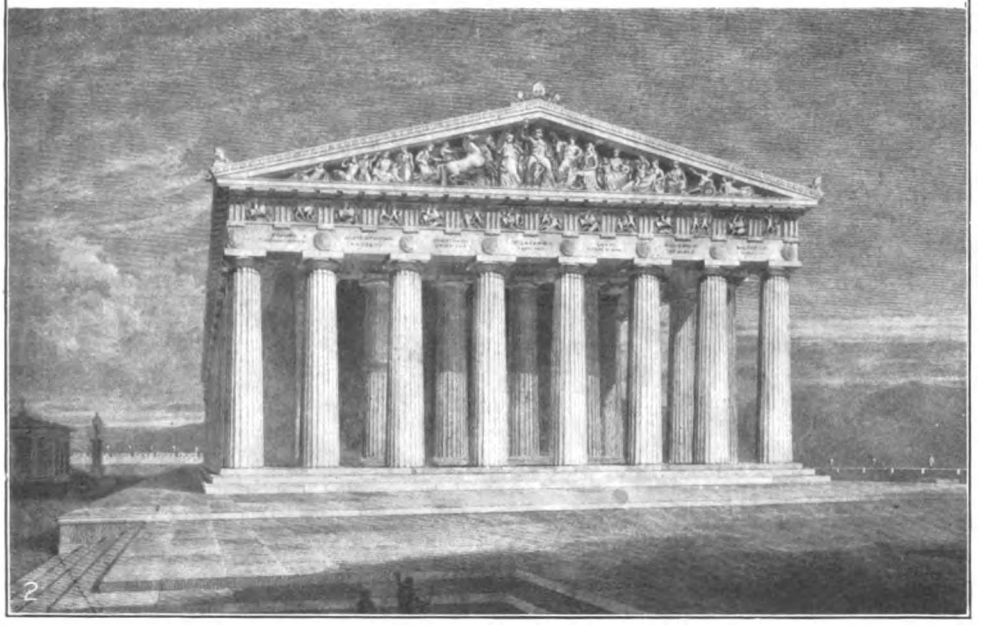
ATHENS, Ala., county-seat of Limestone County, situated on the Louisville & N. Railroad, 95 miles north of Birmingham. Athens has a cotton factory, knitting mill, sash, door and blind factory, two large lumber mills and State Agricultural School. It is the seat of Athens Female College, opened in 1843, under ownership and direction of North Alabama Conference, Methodist Episcopal Church south, and also of Greens University and Trinity College (colored). It has five churches for whites and several churches for colored population, and two newspapers. Surrounded by a splendid agricultural country and has many advantages. City owns and operates water and light plant and the town has an excellent sewer system. City also owns and operates a dispensary.

During the Civil War Colonel Campbell with 600 Federal troops surrendered here on 23 Sept. 1864 to the Confederate forces under General Forrest. Pop. 2,000.

ATHENS, Ga., a city and county-seat of Clarke County, on the Oconee River, and the Central of G., the Georgia, the Southern, the Gainesville M. and the Seaboard A. L. railroads, 67 miles east of Atlanta, the State capital. It is in a cotton-growing region; has a large trade in that staple; and contains cotton and woollen, cotton-seed oil, bobbin and hosiery mills, iron works, furniture factories, and other industrial plants. The United States census of 1914 recorded 48 manufacturing plants of factory grade, employing 1,480 persons, of whom 1,398 were wage earners, receiving $450,000 annually in wages. The capital invested amounted to $3,230,000, and the year's output was valued at $3,023,000: of this, $1,080,000 was the value added by manufacture. It is the seat of the University of Georgia, the State College of Agriculture and Mechanic Arts, Lucy Cobb Institute, Knox Institute, Jeruel Academy, and a State Normal School. There are electric light and street railway plants, a public library, two national banks, several hotels and daily, weekly and monthly periodicals. The waterworks are owned and operated by the city. The government is vested in a mayor elected for two years, and a council. The assessed property valuation exceeds $6,000,000. Athens was first settled in 1801. Pop. (1910) 14,913; (1917) 17,000.

ATHENS (ancient Greek, *Athēnai*), Greece, the capital of the kingdom anciently the capital of the state of Attica and the centre of Greek culture. Its origin and early history are shrouded in darkness. It is situated in the central plain of Attica, which is bounded on the north and northwest by Mounts Parnes and Ægaleos, east and northeast by Pentelikon and Hymettos and on the south by the Saronic Gulf or Gulf of Athens, an arm of the Ægean Sea, running in between the mainland of Greece and the Peloponnesus from which Athens is about four miles distant. The site is irregular, the city having been built on and around several hills rising from the plain, Mount Lycabettus, on the northeast, overlooking the whole. The principal eminence within the city boundary was the Acropolis, the site first built on; west from the Acropolis was a lower hill, called the Areopagus; southwest from the Areopagus was the Pnyx and south from the Pnyx the Museum Hill; toward the sea on the south the view was unimpeded. On the east of the city was the stream known as the Ilissus, and on the west the Cephissus. On the Acropolis, the Pnyx and the line of hills that run north and south to the west of it traces of numerous dwellings cut in the rocks have recently been found. At its most flourishing period, in the 5th century B.C., Athens was connected with its port-town Piræus and the harbors of Cantharus, Zea and Munychia by two massive walls called the "Long Walls" 550 feet apart. It is thought that a third wall ran to the less important harbor of Phalerum but this was not rebuilt after its destruction at the close of the Peloponnesian War. The first harbor was considered the most convenient, and was one of the emporiums of Grecian commerce. Piræus was considered part of Athens, the joint city being often termed the Polis while Athens proper was called Asty. The surrounding coast was covered with magnificent buildings, whose splendor vied with those of the city. The walls of rough stone which connected the harbors with the city were about 10 feet thick and 60 feet high. The Acropolis contained the most splendid works of art of which Athens could boast. Its chief ornament was the Parthenon or Temple of Athena Parthenos (the Virgin). This magnificent building was 228 feet long, 101 broad and 66 high. It was built under the administration of Pericles, on the site of a temple started probably by Themistocles, and was finished in 438 B.C. It was of the Doric order of architecture, and was built of Pentelic marble, resting upon a basement of limestone. The architects were Callicrates and Tetinos. It had columns on all sides, eight at either front and 17 at the sides, counting the corner columns twice. These columns were fully six feet in diameter at the base, and 34 feet high. The structure was adorned both within and without, with statues, reliefs and other sculptures. The frieze and pediments — remains of which are now in the British Museum — are ascribed to Phidias. Inside the temple stood the statue of Athena by Phidias, a masterpiece of art, 42½ feet high, the unclothed portions formed of ivory, the drapery of plates of gold, the value of which was estimated at 44 talents (about $750,000). The Propylæa, a magnificent building, built of white Pentelic marble, begun in 437 B.C. and probably never completed according to the original plan, formed the entrance to the Acropolis, of which it covered the whole western end. A splendid marble stair, 70 feet broad, led up to the Propylæa. The chief building on the Acropolis, in addition to the Parthenon and the Propylæa, was the Erechtheum, a kind of double temple, especially sacred to Athena Polias (or Athena, guardian of the city), and Erechtheus and possibly also Poseidon. On the Acropolis also were other temples, altars, statues, etc., including a colossal bronze statue of Athena Promachos by Phidias, about 30 feet high. On the south slope of the Acropolis were the theatre of Dionysus, the sanctuary of Asclepius, the Odeum of Pericles, and the later Odeum of Herodes, the latter two buildings being intended for musical competitions. In the lower city the greatest pieces of architecture were the so-called temple of Theseus (more probably temple of Hephæstus), and the temple of Olympian Zeus, one of which stood on the northwest, the other on the southeast side of the Acropolis. The first was of Doric architecture, and resembled the Parthenon. On the metopes of this temple the famous deeds of Hercules and Theseus were excellently represented. The temple of Zeus Olympius was of Corinthian architecture, and was the largest temple in Athens, and the greatest ever erected to the supreme deity of the Greeks. It was begun by Pisistratus about 530 B.C., and continued from time to time until at length, after 700 years, it was finished by Hadrian. The outside of this temple was adorned by 104 fluted columns, 56½ feet high and 5½ feet in diameter. It was 354 feet long and 135 broad. Other structures deserving of notice were the Horologium of Andronicus Cyrrhestes or the





PARTHENON AND ACROPOLIS

1 Acropolis from the Hill of the Museum

2 Parthenon (west front) restored

"Tower of the Winds," the choragic monument of Lysicrates, and the Stoa Poikilē or Painted Porch, in the Hellenic Agora or Market. Besides these wonderful works of art Athens contained many other places which must always be interesting from the recollections connected with them. Such a spot was the renowned Academy where Plato taught, lying about six stadia (¾ of a mile) north of the city, and consisting of a gymnasium surrounded by walks, groves and fountains. Such a place was the Lyceum, where Aristotle taught, and which, through him, became the seat of the Peripatetic School. It lay on the bank of the Ilissus, opposite the city, and was also used for gymnastic exercises. Not far from thence was the less renowned Cynosarges, where Antisthenes, the founder of the Cynic School, taught. The sects of Zeno and Epicurus held their meetings in the city. Zeno chose the well-known Poikilē, and Epicurus established himself in a garden within the walls, for he loved both society and rural quiet. Not only literary but political assemblies gave a particular interest to different places in Athens. Here was the court of Areopagus, where that illustrious body gave their decisions; the Prytaneum or centre of official life and the Buleuterium or senate-house; the Pnyx, where the free people of Athens deliberated. After 23 centuries of war and devastation, of changes from civilized to savage masters, have passed over this great city, its ruins still excite astonishment. The northern wing of the Propylæa is still tolerably perfect, and the inner wall, with its five gateways leading into the Acropolis, still stands. The Parthenon remained almost entire till 1687, when it was much injured by an explosion of gunpowder during the siege of Athens by the Venetians. It is now a magnificent ruin. Its two pediments represented, respectively, the contest of Poseidon and Athena for Athens and the birth of the goddess, while the metopes represented the battles of the gods and the giants, of the Athenians and the Amazons, of the Centaurs and Lapithæ, and lastly the siege of Troy and victory over the Persians. The celebrated frieze depicted the great Panathenaic procession in honor of the goddess. A great number of these sculptures are now in the British Museum. In the whole of this mutilated building we find an indescribable expression of grandeur and sublimity. Near the Propylæa is the small but elegant Ionic temple of Athena Nike or Nikē Apteros (Wingless Victory), which having been destroyed in 1687, was re-erected in 1835 from its remains. There are well-preserved remains to be seen of the Erechtheum, especially the beautiful female figures called Caryatides, supporting the roof of the southern portico. The Tower of the Winds is still tolerably perfect. Its form is an octagon; on each side it is covered with reliefs, which represent one of the principal winds. The choragic monument of Lysicrates also remains. It consists of a pedestal surrounded by a colonnade, and is surmounted by a dome of Corinthian architecture. In southeast Athens are the lofty ruins of the temple of the Olympian Zeus. Of 104 pillars 16 remain, but none of the statues are in existence. The pedestals and inscriptions are scattered here and there, and partly buried in the earth. The main body of the temple of Hephæstus has remained almost entire, and is the best preserved edifice of the ancient Greek world; it now contains a Byzantine collection. On the hill where the famous court of Areopagus held its sittings are to be seen steps hewn in the rock, a roughly leveled platform and cuttings in the rock. The Pnyx, the place of assembly for the people, not far from the Areopagus, is very nearly in its primitive state. One may see the place from which the orators spoke hewn in the rock, the seats of the scribes, and at both ends the places of those officers whose duty it was to preserve silence, and to make known the events of public deliberations. The niches for votive offerings are still to be seen. The spot occupied by the Lyceum has not been exactly identified. The ground occupied by the gardens of the Academy is still well cultivated and fertile. The long walls are totally destroyed, though the foundations are yet to be found on the plain. The Piræus has scarcely anything of its ancient splendor, except a few ruined pillars scattered here and there, though it promises to become a handsome modern town and has again a harbor filled with shipping, engaged in carrying on a considerable trade. The ancient Stadium, 670 feet long by 109 wide, where the Panathenaic games were held, first constructed by Lycurgus, c. 330 B.C., and rebuilt in white marble by Herodes Atticus, 140 A.D., has recently been magnificently restored through the generosity of another Greek merchant, M. Averoff, in accordance with the ancient remains. The Olympic games were held here in 1896 and 1906. Ancient Athens is believed to have had a population of not more than 200,000.

Athens was at no time so splendid as under the Antonines, when the magnificent works of from 8 to 10 centuries stood in view, and the edifices of Pericles were in equal preservation with the new buildings. Plutarch himself wonders how the ancient structures could retain such a perpetual freshness. Pausanias, who traveled in Greece at this time, that is, in the 2d century A.D., has left a valuable account of the state of Athens as he saw it. Many of the edifices of later times were due to foreign potentates, rulers of Pergamus, of Egypt, of Rome. But after a time the wholesale robberies of collectors, the removal of great quantities of the works of art, first to Rome and then to Constantinople, Christian zeal, and the attacks of barbarians, made sad inroads among the monuments. When Justinian closed the schools of the philosophers in 529, Athens soon ceased to be a centre of intellectual activity. The Parthenon was turned into a church of the Virgin Mary, and Saint George stepped into the place of Hephæstus. In 1456 Athens fell into the hands of the Turks, under whom the Parthenon became a mosque. In 1687 it was partially destroyed by the Venetians. When it was selected as the capital of the modern kingdom in 1834, it had only a scanty population inhabiting a scene of ruins.

Modern Athens lies mostly northward and eastward from the Acropolis, and consists of well-built streets, the most important being Piræus, Athens, Stadion and University, which radiate from the Place de la Concorde. Among the principal buildings are the royal palace, the university, the academy of science and art, the polytechnic, the national museum, the observatory, the chamber of deputies, exhibition build-

ings, new theatre and new library. The palace (1834–38) is a conspicuous but unattractive building of limestone with marble portico. The beautiful gardens were laid out by Queen Amelia. The National University, founded in 1837, is a handsome structure, with a large number of teachers and an attendance of over 2,500 students. The academy is a beautiful building faced with Pentelic marble; the new National Library, also the University Library, is a fine building, containing 250,000 volumes and 2,300 manuscripts, and so is the Polytechnic School, part of which is occupied as a museum. The National Archæological Museum, built 1866, contains the Schliemann and other priceless collections of antiquities. There is another interesting museum on the Acropolis. The Metropolitan Church is a tasteless modern structure. More noteworthy is the Small Metropolis dating from the 9th century, the oldest of the Byzantine churches. Athens is well equipped with educational institutions, possessing besides the National University and Polytechnic School, a number of high schools, a gymnasium, a school for the higher education of girls and female teachers, orphanages for boys and girls, and a national and four foreign archæological schools or institutes, the French, German, American (opened 1882) and British. The city is governed by a mayor elected every four years, with a council of 18 members. There is a municipal fire department and the city controls the gas, electric light and water works, but the water supply is so inefficient that the inhabitants are obliged to have recourse to water carriers. Street cars cross the city in all directions and it is an important railroad centre. The bathing resort of Phaleron, adjoining the port of Piræus, is connected with Athens by a suburban railroad. The city has very little manufacturing, although the financial centre of the kingdom, and its trade is concerned chiefly with its own requirements. Its industrial and commercial activities are centred in the Piræus, now the chief port of the Ægean, with a population of 73,579. Pop. 167,479.

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ATHENS, N. Y., village of Greene County, on the west bank of the Hudson River; on the West Shore Railroad, connected with the New York Central by ferry; State road trunk line connects with Berkshires. The chief industries are fruit raising and the manufacture of textiles, knit-goods and ice tools. It contains a self-sustaining public library, a high school, six grade schools and a bank with a capital of $25,000; taxable property valued at $1,450,374. Pop. 2,900.

ATHENS, Ohio, city and county-seat of Athens County, 75 miles southwest of Columbus, situated on the Hocking River and the Baltimore & O. S. W., the Toledo & O. C., the Hocking V., the Kanawha & M. railroads, and Hocking Sunday Creek Traction line. Athens is in the heart of a rich coal mining region and fruit belt, and has important clay industries, brick and woodworking plants. It has four banks, with a combined capital of $2,000,000; a government building worth $100,000; courthouse, city building, State armory (costing $20,000), children's home, infirmary, six large churches and a Carnegie library. It is the seat of the Ohio State University (q.v.), the State Normal School and the State Hospital for Insane. There is an annual summer school with a large attendance. Taxable property is valued at about $8,000,000. There are 15 miles of paved streets. Natural gas and a central power plant make fuel and power exceptionally cheap. Athens was settled in 1797, and in 1811 was incorporated. The government is by a mayor, elected every two years, and a city council. The town owns and operates the waterworks (reservoir system). The government receipts and expenses are about $35,000 a year. Pop. (1910) 5,463; (1916) 6,500.

ATHENS, Pa., borough of Bradford County, near the New York State line, on the Lehigh Valley Railroad, and on the Chemung and Susquehanna rivers. It has manufactories of cigars, overalls, tools and furniture, and contains in addition planing mills, silk mills, foundries, boatworks and milling and produce companies. Pop. 3,796.

ATHENS, Tenn., town and county-seat of McMinn County, on the Southern Railway, half way between Knoxville and Chattanooga, 56 miles to either city. The town was laid out in 1823 and incorporated in 1868. It has woolen mills, spinning mills, lumber factories and two newspapers. It is the seat of the Methodist-Episcopal Grant Memorial University. Pop. 3,000.

ATHENS, Texas, city and county-seat of Henderson County, at the junction of the Saint Louis & S. W. and the Texas & N. O. railroad, 75 miles southwest of Dallas. It is situated in a cotton, fruit and vegetable-growing region, which also contains coal and hard and soft timber. Athens is an important manufacturing town and has pressed brick, fire brick and tile works, cotton-oil mills, potteries and other industries. There are excellent public schools, a fine courthouse, four churches and two national banks. Athens was first settled in 1850 and was incorporated as a city in 1901. The waterworks are owned by the municipality. Pop. 3,000.

ATHENS, American School at, an institution for classical study, founded in Athens, Greece, in 1882. It is affiliated with the Archæological Institute of America and is managed by a committee representing the colleges in the United States which contribute to its support. The building was erected by means of private subscriptions on grounds donated by the Greek government, and the institution has an endowment of $50,000.

ATHENS OF AMERICA, a name frequently applied to Boston, Mass., on account of her intellectual and literary pre-eminence.

ATHENS OF THE NORTH, a name given to Edinburgh, Scotland, on account of the picturesqueness of the site and beauty of architecture, as well as intellectual distinction. Copenhagen also is often so called.

ATHENS OF THE WEST, a name given to Cordova, Spain, the centre of Arab learning and culture in the Middle Ages.

ATHERINE, a small fish, from five to six inches long, called also the sandsmelt.

ATHEROMA, properly a wen (sebaceous cyst), so named from the porridge-like character of the contents. The term is applied also to the later stages of arteriosclerosis when the fatty and calcareous degeneration of the coats of the aorta and other arteries manifests itself in yellow patches of induration or of softening. See ARTERIES, DISEASES OF.

ATHERTON, Charles Gordon, American politician: b. Amherst, N. H., 1804; d. Manchester, N. H., 15 Nov. 1853. He was graduated from Harvard in 1822, was a member of the New Hampshire legislature for five years and speaker of the lower house for four, and in 1837–43 was a Democratic representative from New Hampshire in Congress. In 1843–49 and 1852–53 he was a member of the Senate. On 11 Dec. 1838 he introduced in the House the so-called "Atherton gag" resolution, which provided that all bills or petitions on the subject of slavery should be "laid on the table without being debated, printed or referred." The resolution was passed by a vote of 126 to 73, and remained in effect until 1844. It was resolutely opposed by J. Q. Adams, who advocated the "right of petition." Adams was ultimately victorious and on 3 Dec. 1844 the 21st rule of the House, providing that no paper praying the abolition of slavery or the slave trade should be in any wise entertained, was abolished by a vote of 108 to 80. See GAG-RULES.

ATHERTON, George William, American educator: b. Boxford, Mass., 20 June 1837; d. Bellefonte, Pa., 24 July 1906. He worked his way through Phillips Exeter Academy and Yale College; was professor of political economy and constitutional law in Rutgers College, N. J., in 1869–82; was admitted to the bar of New Jersey in 1878; and from 1882–1906 was president of the Pennsylvania State College.

ATHERTON, Gertrude Franklin (HORN), American novelist: b. San Francisco. Since the death of her husband she has chiefly pursued a literary career. She has written 'The Doomswoman' (1892); 'Before the Gringo Came' (1894); 'A Whirl Asunder' (1895); 'Patience Sparhawk and Her Times' (1897); 'American Wives and English Husbands' (1898); 'The Californians' (1898); 'A Daughter of the Vine' (1899); 'The Valiant Runaways' (1899); 'Senator North' (1900); 'The Aristocrats' (1901); 'The Conqueror' (1902); 'The Splendid Idle Forties' (1902, a revision of 'Before the Gringo Came'); 'Rulers of Kings' (1904); 'The Bell in the Fog' (1905); 'The Travelling Thirds' (1905); 'Rezanov' (1906); 'Ancestors' (1907); 'The Gorgeous Isle' (1908); 'Tower of Ivory' (1910); 'Julia France and Her Times' (1912); 'Perch of the Devil' (1914); 'California: An Intimate History' (1914); 'The Conqueror' (23d ed., 1915); 'Mrs. Balfame' (New York 1916).

ATHERTON, a manufacturing town of England, Lancashire, 13 miles northwest of Manchester, containing cotton-factories, collieries, iron-works. Pop. 18,982.

ATHERTON RESOLUTIONS. See GAG RULES.

ATHETOSIS, a peculiar movement, usually of the hands and fingers, occurring after some destructive process in the brain. It is seen in the young who have suffered severe injuries at birth and sometimes following an apoplectic stroke.

ATHIEST, The, last of Otway's plays, produced in 1684. It is a continuation of 'The Soldier's Fortune,' the plot being taken from 'The Invisible Mistress,' a French novel, written by Scarron.

ATHIEST'S TRAGEDY, The, or, the Honest Man's Revenge. The title of a play by Cyril Tourneur and generally considered one of his best. It is supposed to have been written in 1600, though it was not published until 11 years later. The plot is obviously suggested by some of the crude tales of the 'Decameron' of Boccacio.

ATHLETE, The, a statue found in Pompeii and now in the Museo Nazionale at Naples. It is a copy of the spear bearer of Polycletus. So beautifully shaped and proportioned is it that it is regarded as the ideal of physical manhood.

ATHLETES (Greek, *athlētai*), combatants who took part in the public games of Greece; also young men who went through the gymnastic exercises to harden themselves and to become fit to bear arms. In a narrower sense athletes were those who made the athletic or gymnastic exercises their principal business, particularly wrestlers and boxers. Their business was to contend at the public festivals, and they regulated their habits of life for this end. Not only the applause of the people, but also crowns and statues, were conferred upon the victor. He was led in triumph; his name was written in the public records; and poets sang his praise. He also received peculiar privileges, had a yearly pension and the foremost seat at the sacred games.

ATHLETICS, or **ATHLETISM,** is the exhibition of man's physical prowess in games of skill and endurance, and though in passing centuries it has undergone many phases, it is practically the same to-day as when the Olympian games, which were resumed at the Pan-American Exhibition at Buffalo in 1901, were originally given 2,500 years ago, and Greece was in her prime. Then not only Greek met Greek, but the influence of the Olympian, Pythean, Nemean and Isthmian games was felt to the farthest extreme of Asia. After the fall of Rome, the mantle of physical prowess which that nation had inherited from the Greeks fell upon the shoulders of the sturdy Norseman, whose chief glory was in his individual capacity to bear unflinchingly the stress and strain of

contests and the elements. They bred into the bone the hardihood and love of personal achievement which in turn carried the current through the Dark Ages, even into those of the exaggerated chivalry, which Cervantes killed with ridicule in 'Don Quixote.' The spirit of the Greek, Roman and Norseman planted its seeds in the hardy Anglo-Saxons, who in turn transplanted them into Virginian and New England soils on the northern continent of America, where its influence has been felt, even to the entire disappearance of the softer Latin races' supremacy. It is not surprising, therefore, that, with the disappearance of the earlier modes of life of the first settlers, calling for all the physical strain that the human frame was capable of, and the return of the comparative leisure which in early youth now surrounds the American universities and colleges, there has reappeared a yearning after opportunities to supply, artificially, if so it must be, the stress and contest, physical effort and the proof of supremacy of the earlier ages, when such conditions were compulsory. It was in the blood, and it came out, much to the nation's benefit. First in the form of isolated college and club contests, and subsequently in such a volume as to need a separation of contests into classes and the creation of an especial federation of the separate units, to regulate and control it. In the beginning, athletics developed in this or that college, or university or club, acting separately and indiscriminately in its scope. Ultimately the lines of natural cleavage forced athletics into its two great branches: one outdoors, commonly known as track-events; the other, those carried on in a gymnasium. The outdoor events are those which are now usually meant when the term athletics is used. The development of these came tentatively. First one college, or university, or club, then another, organized outdoor contests, until at length the net was spread over all the rising generation, and the Amateur Athletic Union was formed, whose fundamental rule is that "no person shall be eligible to compete in any athletic meeting, game or entertainment given or sanctioned by this Union who has (1) received or competed for compensation or reward, in any form, for the display, exercise or example of his skill in or knowledge of any athletic exercise, or for rendering personal service of any kind to any athletic organization, or for becoming or continuing a member of any athletic organization; or (2) has entered any competition under a name other than his own, or from a club of which he was not at that time a member in good standing; or (3) has knowingly entered any competition open to any professional or professionals, or has knowingly competed with any professional for any prize or token; or (4) has issued or allowed to be issued in his behalf any challenge to compete against any professional, or for money; or (5) has pawned, bartered or sold any prize won in athletic competition; or (6) is not a registered athlete. Nor shall any person residing within the territory of any active member of this Union be eligible to compete for or to enter any competition as a member of any club in the territory of any other active member of this Union, unless he shall have been elected to membership in such club prior to 1 April 1891; provided, however, that this restriction as to residence shall not apply to undergraduates connected with any allied college athletic organization.

"No one shall be eligible to compete in any athletic meeting, games or entertainment given or sanctioned by this Union, unless he shall be a duly registered athlete, a member of the organization from which he enters, and shall not have competed from any club in this Union during a period of three months next preceding such entry; nor shall any member of any club in this Union, or any club in any district in this Union be allowed to compete in case he has within one year competed as a member of any other club then in this Union, except with the consent of such other club, which consent shall be filed with the registration committee of his district prior to such competition unless such other club shall have disbanded or practically ceased to exist; provided that the requirements of this section shall not apply to any athletic meeting, games, or entertainment, the entries for which are confined to the club or organization giving such meeting or entertainment.

"No athlete who has been released from a club which is a member of this Union, and who competes for another club directly thereafter, shall be allowed to compete again for the club he was released from for one year from the date of his release, except that the club has disbanded or ceased to exist.

"No person shall be eligible to compete for or enter any competition as a member of any club in the territory of any active member of this Union, unless he shall have resided within the territory of said active member at least four months previous to entering for competition; nor shall any person be eligible to enter or compete in any district championship meeting unless he shall have been a bona-fide resident of such district for at least six months prior to the holding of such championship meeting; and no person shall be eligible to compete in a championship meeting of more than one district in one year. The restrictions contained in this section shall not affect the eligibility of an undergraduate connected with any allied college athletic organization who shall have been elected to membership in any club of this Union prior to 20 Nov. 1899, to represent such club as long as he remains an undergraduate; nor shall these restrictions apply to an undergraduate competing for any college belonging to an allied body."

The Amateur Athletic Union (A. A. U.) of the United States has jurisdiction over the following games or sports: Basketball, billiards, boxing, fencing, gymnastics, handball, hurdle, racing, jumping, lacrosse, pole vaulting, putting the shot and throwing the discus, hammer and weights, running, swimming, tugs of war, walking and wrestling. The Union consists of the *Metropolitan Association* comprising the States of New York, New Jersey, north of Trenton; the *New England Association*, comprising Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut; the *Atlantic Association*, comprising New Jersey, south of and including Trenton, Delaware, Maryland, Pennsylvania, West Virginia, District of Columbia, Virginia, North Carolina and South Carolina; the *Central Association*, comprising Ohio, Illinois, Indiana, Michigan, Wisconsin,

Iowa and Minnesota; the *Pacific Association*, comprising California, Arizona, Nevada and Utah; the *Southern Association*, comprising Alabama, Louisiana, Florida, Mississippi, Texas, Georgia and Tennessee; the *Western Association*, comprising Missouri, Wyoming, Arkansas, Oklahoma, South Dakota, North Dakota, Indian Territory, Kansas, Kentucky, New Mexico and Colorado; and the *Pacific Northwest Association*, comprising Idaho, Montana, Oregon, Washington and Alaska. All its meetings are under the direction of "a games committee," one referee, two or more inspectors, three judges at finish, three or more timekeepers, a starter, a clerk of the course, a scorer and a marshal; besides which all the conditions and restrictions for various events: the number of throws allowed, the size and area of preliminary effort, as in shot-putting, etc., are subject to definitions from time to time promulgated, and imposed, by virtue of the authority of the A. A. U. in meeting assembled.

The Intercollegiate Association of Amateur Athletes of America is the governing body of intercollege athletics. Its championship must be won at the annual meeting. The events at outdoor field meetings, track and field athletics, as they are more closely defined, include the following:

Flat racing, subdivided into sprint, middle-distance and long-distance races. "Sprinting" signifies top speed running, up to 300 yards. "Middle-distance" events are the half-mile, mile and two-mile race, longer stretches being "long-distance."

Hurdle racing, covering two events, the 120-yard and 220-yard hurdle race. The first is run over 10 flights of hurdles, 10 yards apart, the first being 15 yards from the start, each hurdle being three and a half feet in height. The 220-yard race is over 10 hurdles two and a half feet high, the conditions being otherwise the same.

Jumping, including the broad jump, the high jump and the pole vault. The first is a running jump from the edge of a plank sunk into the track, with a distance as the main object. The high jump is over a bar, with height as the main object. Vaulting is the same as high jumping, except that the athlete has the assistance of a 14-foot pole.

Weight events, including throwing the hammer, putting the shot and throwing the discus. In the first a 16-pound hammer with a four-foot flexible wire handle is thrown with both hands from a seven-foot circle, the hammer being swung around the head. Putting the shot consists of throwing a 16-pound iron ball straight from the shoulder with one hand. Throwing the discus is somewhat similar; the discus, a flat, circular stone or piece of meal, weighing four pounds and seven ounces, is hurled from a nine-foot square.

The following table shows some of the principal American Amateur Athletic records:

Event	Record	When made	Champion
100 yard dash	9 3/5 seconds*	23 June 1906	Dan J. Kelly.
440 yard run	47 seconds*	29 Sept. 1900	M. W. Long.
1 mile run	4 minutes 12 3/5 seconds*	16 July 1915	N. S. Taber.
5 mile run	25 minutes 8 seconds	1 Nov. 1913	H. Kolehmainen.
25 mile run	2 hours 44 5/6 minutes	8 Jan. 1909	M. Maloney.
120 yard low hurdles	14 2/5 seconds	6 Sept. 1909	J. J. Eller.
120 yard high hurdles	15 seconds*	10 May 1913	F. W. Kelly.
Standing high jump	5 feet 5¼ inches*	14 June 1913	Leo Goehring.
Running high jump	6 feet 7 5/16 inches*	2 May 1914	E. Beeson.
Pole vault	13 feet 2½ inches*	8 June 1912	M. S. Wright.
Throwing hammer	189 feet 6½ inches*	17 Aug. 1913	P. Ryan.
Putting shot (16 lb.)	51 feet*	21 Aug. 1909	Ralph Rose.
Throwing discus (Olympic style)	156 feet 1⅛ inches	27 May 1912	James Duncan.

* Also world record.

See also AMATEUR; GYMNASTICS; EDUCATIONAL ATHLETICS.

Bibliography.—Stonehange, 'Rural Sports' (illustrated edition); Cassell, 'Sports and Pastimes' (with 700 illustrations); 'Athletics' (by various authors, in the 'Encyclopedia of Sports'); Sullivan James, 'Athletic Almanacks' (issued yearly); Graham and Clark's 'Practical Track and Field Athletics' (1910); 'Spaulding's Athletic Library' (Official Athletic Almanac, annual).

ATHLONE, ăth-lōn', Ireland, town on the Shannon, about 67 miles west by north of Dublin. It is divided by the river into two nearly equal parts, which communicate by a handsome stone bridge of five arches. It is one of the chief depôts for troops and military stores; and the barracks, occupying a height above the river, can accommodate 15,000 men, and have attached an ordnance yard, magazines and armory provided with a large stand of arms. By means of a canal the Shannon has been rendered navigable for 71 miles above the town, which, being also terminus of four important railways, carries on a brisk trade. The chief industrial establishment is an extensive woolen factory, and there are also large saw-mills. Pop. 9,631.

ATHOL, Mass., town in Worcester County, on Miller's River and the Boston & A. and Fitchburg railroads, 26 miles northwest of Worcester. It contains several villages, has electric railways connecting with the suburbs, municipal water works, and is principally engaged in the manufacture of cotton warps, shoes, sewing-silk, fine mechanical tools, matches, organ-cases, pocketbooks, billiard-tables and furniture. The town has two national banks, public library, high school, several weekly and monthly periodicals, and a property valuation exceeding $4,000,000. From its settlement in 1735 until its incorporation in 1762, Athol was known as Pequoig. Pop. (1910) 8,536.

ATHOL, or **ATHOLE,** a mountainous and romantic district, situated in the north of Perthshire, Scotland. It gives the title of duke to a branch of the house of Murray, and the Duke owns the greater part of the district.

ATHOR, ä'thôr, **HATHOR** or **HETHER,** an Egyptian goddess, identified with Aphrodite (Venus). Her symbol was the cow bearing between its horns the solar disc and hawk feather plumes. Her chief temple was at Denderah. From her the third month of the Egyptian year derived its name.

ATHOS, now **HAGION OROS** or **MONTE SANTO** (Holy Mountain), a high mountain in Macedonia, 50 miles east of Salonica, the extremity of a long chain of mountains which runs through a peninsula jutting into the Archipelago. The peninsula is about 30 miles long and five miles broad. It is covered with forests of various kinds of trees, and with vineyards and plantations of olive and other fruit-trees. The surface is very irregular, and the coast displays numerous creeks and inlets of the sea. In ancient history the peninsula is mentioned chiefly on account of the shipwreck which here befell the Persian fleet under Mardonius in 493 B.C., and on account of the canal which, in order to avoid a similar calamity, Xerxes caused to be cut through the isthmus that joins the peninsula to the mainland. The whole peninsula, as well as the mountain, which is about 6,700 feet above the level of the sea, receives the name of Athos. It contains some 20 monasteries, and a multitude of hermitages, inhabited by about 6,000 monks and hermits of the Order of Saint Basil. They are extremely industrious: they diligently cultivate the soil, grow vines and olives, vegetables, etc., and actively engage in fishing, and they also carve statues of the saints, *Agni Dei,* crucifixes, rosaries, etc., which they send to the small town of Karyes, on the mountain, where weekly markets are held, and to the rest of Europe, especially to Russia. They also collected alms to pay their heavy yearly tax to the Porte. There is an academy in which the younger monks receive instruction in various subjects. The libraries of the monasteries are rich in literary treasures, particularly in manuscripts, partly procured from Constantinople before its conquest by the Turks, partly presented to them from the same place, and partly written by the laborious monks. Many books have been brought thence to the great collections at Paris, Vienna, etc., and the rest are but little used among the monks themselves. Their monasteries and churches were the only ones in the Ottoman empire which had bells. Every nation belonging to the Greek Church has here one or more monasteries of its own, annually visited by pilgrims from Russia, Serbia, Bulgaria, etc., as well as from Greece, Asia Minor and Constantinople. The privileges which the members of the various establishments enjoy they owe to Murad II, who, on account of their voluntary submission, even before the capture of Constantinople, granted them his protection. Hermits were established on Athos in the middle of the 9th century, and the first monastery, that of Saint Lavra, was founded by the monk Athanasius in 968. In 1912 Athos was occupied by the Greeks during the Balkan War, and is now under Greek sovereignty.

ATHOS, a'tōs', a character who figures in Dumas' 'Musketeer' novels. He is one of the three guardsmen associated with d'Artagan.

ATHY, ă-thī', a market-town in Ireland, 37 miles southwest of Dublin, with Protestant and Roman Catholic churches, extensive county jail, police barracks, etc. It has a large trade in corn, by canal and river, and is an important railway station.

ATITLAN, ä'tę-tlän', a lake, mountain and town of Central America, in Guatemala. The lake is about 24 miles long and 10 broad; the mountain an active volcano, 12,160 feet high. The town, known also as Santiago de Atitlan, is located on the side of the mountain, and is chiefly known for its medicinal springs. Pop. about 11,300.

ATJEH. See ACHIN.

ATKINSON, Edward, American economist: b. Brookline, Mass., 10 Feb. 1827; d. Boston, 11 Dec. 1905. He was educated in private schools. He invented a cooking-stove called the "Aladdin Oven," and was president of the Boston Manufacturers' Mutual Fire Insurance Company after 1878. His wide reputation was due chiefly to the fact that for 40 years he was a prolific writer of pamphlets on economic, commercial and political subjects, including banking, competition, railroads, fire-prevention, economic legislation, industrial education, the money and tariff questions, and colonial expansion. He vigorously opposed the war in the Philippines, and during 1899–1900 published the *Anti-Imperialist* in support of his views. The following is a selected list of his more important publications: 'Cheap Cotton by Free Labor' (1861); 'Collection of Revenue' (1866); 'Reform of the Legal Tender Act' (1874); 'The Fire-Engineer, the Architect and the Underwriter' (1880); 'Distribution of Products' (1885); 'The Margin of Profit' (1887); 'Taxation and Work'; 'Science of Nutrition'; 'Prevention of Loss by Fire'; 'Fifty Years' Record of Factory Mutual Insurance' (1900); 'Facts and Figures the Basis of Economic Science' (1904). Consult the biographical notice by T. W. Higginson in 'Proceedings of the American Academy of Arts and Sciences' (Boston 1907).

ATKINSON, Eleanor (Stackhouse), American writer: b. Rensselaer, Ind. For several years she was a public school teacher in Indianapolis and Chicago, but in 1889 she took up newspaper work, becoming a special writer on the staff of the Chicago *Tribune.* Here her writing became familiar under the pen name of "Nora Marks." In 1891 she married Francis Blake Atkinson. In 1900 she became editor of *The Little Chronicle,* in which position she continued for seven years. Among her books are 'Mamzelle Fifine' (1903); 'Boyhood of Lincoln' (1908); 'Lincoln's Love Story' (1909); 'The Story of Chicago' (1910); 'The Students' Reference Work' (Vol. V, 1911); 'Greyfriars Bobby' (1912); 'Loyal Love' (1912); 'How and Why Library' (1913); 'Johnny Appleseed' (1915).

ATKINSON, George Francis, American botanist: b. Raisinville, Mich., 26 Jan. 1854. He was educated at Olivet College, Michigan, and Cornell University, and was graduated in 1885. He taught general zoology, biology and ento-

mology in the universities of North Carolina, South Carolina and the Alabama Agricultural and Mechanical College, from 1885 to 1892. He was botanist of the South Carolina Agricultural Experiment Station, 1888–89, and biologist of the Alabama Agricultural Experiment Station 1889–92. He was assistant and professor of cryptogamic botany at Cornell University, 1892–96, and professor of botany there since 1896, and botanist of the Cornell University Agricultural Experiment Station, 1892–1906. He has written 'Biology of Ferns' (1894); 'First Studies of Plant Life' (1904); 'Studies of American Fungi' (1900); 'Mushrooms' (1903); 'Elementary Botany'; 'High School Botany'; 'College Textbook of Botany.' He is a fellow of the American Association Advanced Science; fellow of the Botanical Society of America; member of the American Philosophical Society; member of the American Genetic Association, and corresponding member of the Torrey Botanical Club. He is actively engaged in botanical research and has made numerous original contributions to botanical science in foreign and American journals.

ATKINSON, George Wesley, American writer: b. Charleston, W. Va., 29 June 1845. In 1875 he was admitted to the bar, but the following year he was appointed internal revenue agent. From 1881 to 1885 he was United States marshal in West Virginia. In 1889 he was elected to Congress and in 1897 he was elected governor of his State for a four-years' term. In 1905 he was appointed a judge of the United States Court of Claims. Among his writings are 'History of Kanawha' (1876); 'After the Moonshiners' (1879); 'Handbook for Revenue Officers' (1881); 'A B C of the Tariff' (1882); 'Prominent Men of West Virginia' (1895); 'Psychology Simplified' (1897); 'Public Addresses' (1901); 'Chips and Whetstones' (1908).

ATKINSON, John, American clergyman: b. Deerfield, N. Y., 6 Sept. 1835; d. Haverstraw, N. Y., 8 Dec. 1897. He entered the Methodist ministry in 1853, and held pastorates in Newark, Jersey City, Chicago, Bay City, Adrian and Haverstraw. He was the author of the hymn 'Shall We Meet Beyond the River?' He wrote 'The Living Way' (1856); 'Memorials of Methodism in New Jersey' (2d ed., 1860); 'The Garden of Sorrows' (1868); 'Centennial History of American Methodism' (1884); 'The Beginnings of the Wesleyan Movement in America, and the Establishment Therein of Methodism' (1896).

ATKINSON, John Christopher, English clergyman and antiquary: b. Eddhangor, England, 1814; d. 1900. He was for half a century vicar of the parish of Danby in the North Riding of Yorkshire, which he has described in his delightful 'Forty Years in a Moorland Parish' (1891). He wrote much on natural history, and his 'Walks, Talks, Travels and Exploits of Two School-Boys' (1859); 'Play Hours and Half Holidays' (1880), 'British Birds' Eggs and Nests' (1861), and 'The Last of the Giant Killers' (1891), have been widely read.

ATKINSON, Thomas, American bishop: b. Mansfield, Va., 6 Aug. 1807; d. Wilmington, N. C., 4 Jan. 1881. He was graduated from Hampden-Sidney College, Virginia, in 1825. and practised law for nine years. Ordained priest in the Episcopal Church in 1837, he served as rector in Norfolk and Lynchburg, Va., and Baltimore, Md., whence he was elected third bishop of North Carolina 26 May 1853. He was an able administrator and prominent in the councils of his Church. He published various sermons and Episcopal charges.

ATKINSON, Thomas Witlam, English traveler, writer and artist: b. Yorkshire, 6 March 1799; d. Kent, 13 Aug. 1861. He began his career as an architect in Manchester, where he built a large church. It was in this connection that he acquired a facility for drawing which he later developed into the ability to draw and paint. Becoming interested in central Asia through the works of Humboldt, he went to Saint Petersburg in 1844 and thence began one of the most remarkable series of journeys and explorations ever undertaken. He wandered across the Russian steppes, over the plains of Siberia, into central Mongolia and even ventured into Chinese Tibet, many stretches of this extended journey being undertaken on foot. On returning to England in 1853 he estimated that he had traveled some 30,000 miles, much of it being through country then practically unknown to Europeans. His experiences are related in 'Explorations in Oriental and Western Siberia' (1858) and 'Travels in the Regions of the Upper and Lower Amoor' (1860).

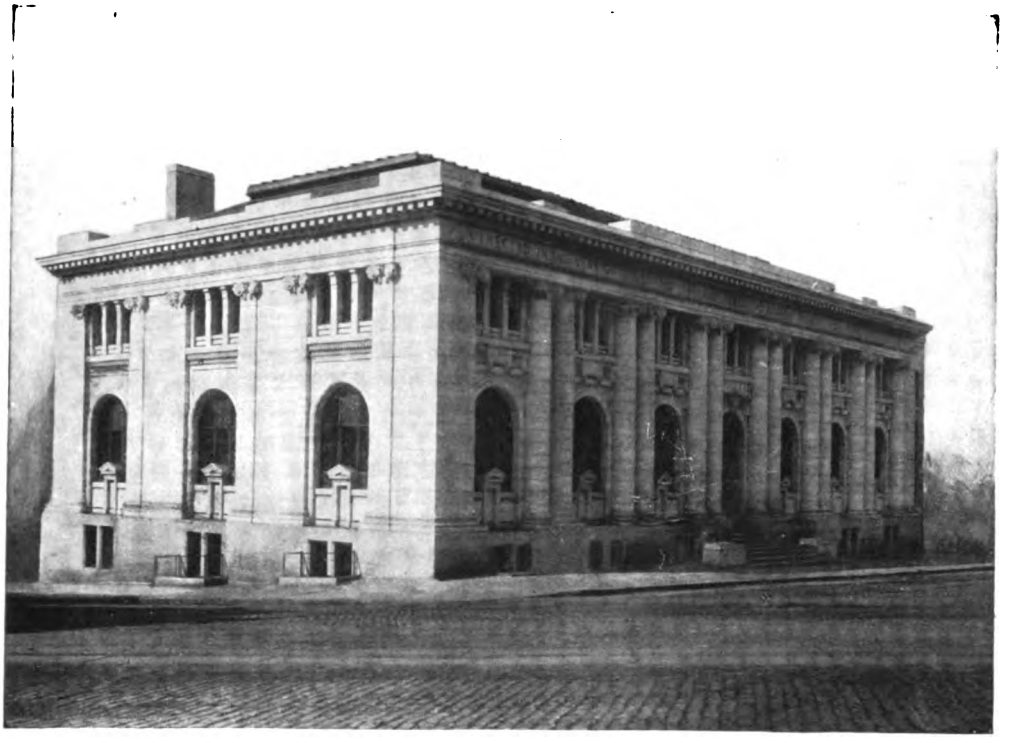
ATKYNS, Sir Robert, English jurist and statesman; b. Gloucester 1621; d. Sapperton Hill, Gloucestershire, 1709. He was the son of a distinguished family, of which no less than four generations had been represented in high judicial offices. In 1659 he entered Parliament and being a strong partisan of the king, he was made Knight of the Bath at the coronation in 1661. In the same year he became recorder of the city of Bristol. In 1672 he was judge of the Court of Common Pleas. But on account of friction with Chief Justice Scroggs he resigned from office in 1680 and retired to his family estate in Gloucestershire. During this period, however, he showed himself bitterly opposed to the Stuarts and after the flight of James II he openly proclaimed himself for the lords, acting as their legal adviser, pleading especially for Lord William Russell. When that nobleman came up for trial in 1683, Atkyns published two pamphlets in his defense. When William III came on the throne he was made Lord Chief Baron of the Exchequer, in which office he remained until 1694. From 1689 to 1693 he was speaker in the House of Lords. His one work was his 'Parliamentary and Political Tracts' (1734).

ATLANTA, Ga., city, capital of the State, and county-seat of Fulton County, 290 miles northwest of Savannah, with railway facilities including 15 radiating lines, five of which belong to the Southern Railway, and three controlled by the Louisville & Nashville system. Belt lines complete the terminal system, which centres in a fine union depot completed at a cost of $1,000,000. Local transportation is unified in a system of well-equipped street railways covering 235 miles of track, 200 within the city, the rest extending eight miles out. Atlanta is locally called the "manufacturing and industrial metropolis of the southeast." The area of the city is 26 square miles, and the

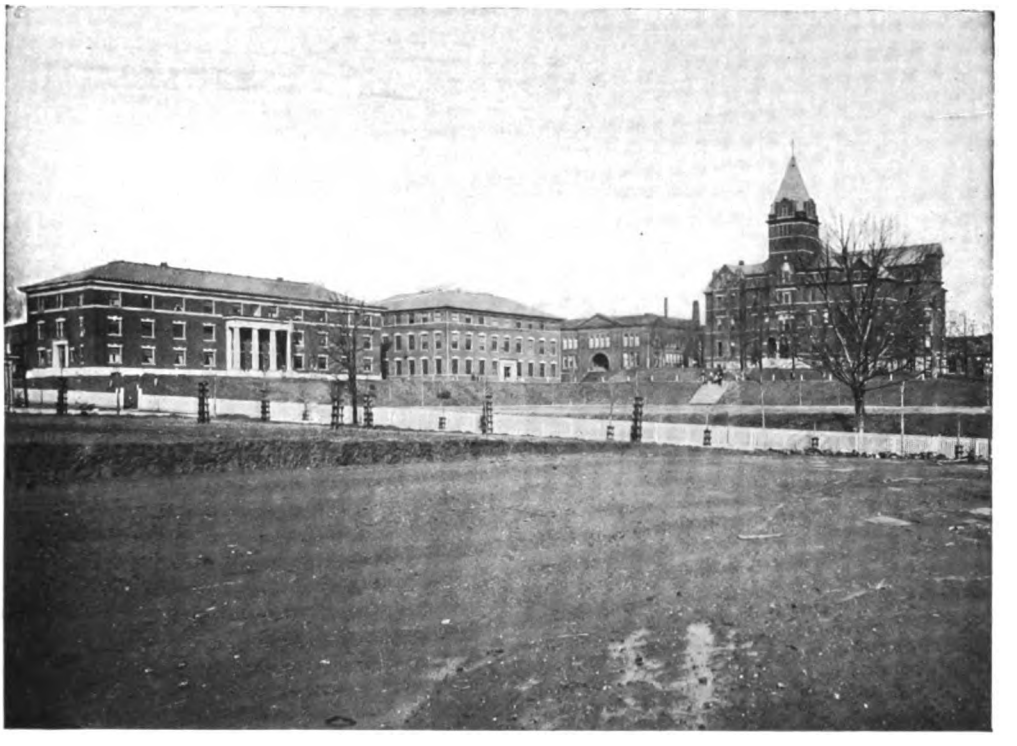
boundary is nearly a circle of 3½ miles diameter, extended in two suburbs. Situated at the foot of the Appalachian chain of mountains on the ridge dividing the watershed of the Atlantic Ocean from that of the Gulf of Mexico, the altitude of 1,050 feet at the lowest point and 1,100 feet at the highest makes the climate cooler than the latitude, 33° 44′ 58.8″, would indicate, and the air has a bracing and invigorating effect conducive to mental and physical vigor which makes Atlanta a desirable place of residence. The mean summer temperature is 77°; winter, 44°. This commanding site was developed by the building of railroads in the first half of the 19th century. The village of Marthasville was first a terminus of the line from Savannah and Macon. As one road after another centred there the place grew rapidly and became known as «Terminus»; its destiny as a business centre was foreseen, and the name changed to Atlanta. Here eastern and western traffic meet. After the vicissitudes of the Civil War, the legislature removed from Milledgeville and Atlanta became the capital of the State during the reconstruction era. It was made the permanent capital by vote of the people in 1887, and the capitol building was completed in 1889 at a cost of $1,000,000. Atlanta became the business centre of the Southeastern States and shared the general growth, developing rapidly after the Cotton Exposition of 1881, projected by citizens of Atlanta, became a rallying point for Southern industry. A second exposition held in 1895 greatly stimulated the growth of business; in 1914 the national government selected Atlanta as a site for the regional bank to serve the Southeastern States of Alabama, Florida, Georgia, Mississippi, North and South Carolina and Tennessee; and in 1915 the annual fair became a permanent fixture. Bank clearings increased from $56,000,000 in 1894 to $739,294,232 in 1915. In the same period bank deposits grew from less than $4,000,000 to $36,216,566. Business increased four times as fast as population, although that has grown at the rate of 4 per cent a year. The wholesale and retail trade of one year is now estimated at $200,000,000. The mule market is now the second most important in the country. Sales for any recent year are estimated at 65,000 head, valued at more than $11,000,000. Total trade and manufactures, $300,000,000. As a manufacturing centre, Atlanta's output is varied. A recent census reported 898 establishments with $62,614,590 of capital, 21,482 wage earners, $14,284,923 total wages, and $55,011,690 of products. The most important products are cotton goods, fertilizers, gins, engines, car-wheels, machinery, lumber, sheet-metal work, terra-cotta, brick, wagons, carriages and buggies, furniture, confectionery, crackers, cigars, coffins, chemicals, printing, lithographing, electrotyping, engraving, paper-bags, flour and meal, paints, varnish, cotton-seed oil and cake, ice, harness, belting, hosiery, suspenders, underwear, neckwear, woolen goods, clothing, trunks and condiments.

The factories of the city use 45,000 horse-power furnished by steam and electricity. A massive masonry dam has been constructed at Bull Sluice Shoals on the Chattahoochee, and a plant costing $2,000,000, completed near the middle of 1904, delivers 11,000 horse-power of electric current in the city. This gave a new impetus to manufacturing, much of the additional power having been taken in advance of completion. Atlanta's central position has made it southern headquarters for large business concerns. It is the fourth insurance centre of the United States, with premium collections estimated at $11,000,000 per annum, and is headquarters for the railways, telegraphs, telephones and the large industrial corporations doing business in the Southern or Southeastern States. The concentration of these interests has created such a demand for quarters that Atlanta has more fireproof office buildings than any other Southern city. A fireproof hotel with over 300 rooms was recently completed. With other excellent hotels, Atlanta has been famous for many years as «A Convention City» and has an auditorium seating 8,000 people. Atlanta is the most important centre of publication for newspapers and periodicals in the Southern States. The postal receipts for second-class matter reach $100,000 in a single fiscal year, thus exceeding those of Brooklyn, Baltimore, Buffalo, Washington city, Omaha, New Orleans, Louisville or Indianapolis, while the increase of general postal receipts since the exposition has been remarkable and now exceed $1,466,000 for a single year. Congress appropriated $200,000 for an entire block of ground upon which a very handsome post-office and custom house has been erected at a cost of $1,000,000. This and the State capitol, already mentioned, with its exterior of oolitic limestone and the interior ornamented with Georgia marble, are the chief among the fine buildings of the city. Street improvements have cost more than $10,000.000, including 292 miles of sewers, 230 of paved streets, 487 of sidewalks. Fifteen miles of streets are paved with asphalt, the remainder with granite blocks, macadam and vitrified brick. The city water works takes its supply from the Chattahoochee River above Peachtree Creek, in a sparsely populated district. By settling and filtration water is purified. Two engines of 15,000,000 gallons daily capacity each pump it into the city. The consumption is nearly 20,000,000 gallons a day. For domestic use water is supplied at 10 cents per thousand gallons. At this rate, with some reduction to manufacturers, the city makes a profit. Fire, police, sanitary and other city departments are well equipped and efficient. The city government is administered by a mayor and general council. Appropriation bills are voted separately by two legislative branches, and the mayor has a veto. Bonded debt is limited by State Constitution to 7 per cent of the taxable wealth. The charter requires a sinking fund to retire all bonds in 30 years from date of issue. Atlanta is one of 10 cities designated by the Secretary of the Treasury whose bonds might be used as security for Federal deposits. The tax rate is 1¼ per cent and the assessment averages 60 per cent of actual value. The city assessment for 1915 showed $185,825,693 of taxable wealth. The streets of the residential sections are particularly attractive with grassy lawns and shade trees. Grant Park, Piedmont Park, Lakewood, East Lake, Ponce De Leon Spring and the Chattahoochee River are outing resorts. A bill has been introduced in Congress to make a national military park on the battle ground north of the city. Public spirit is strong in Atlanta. The Chamber of

ATLANTA, GA.

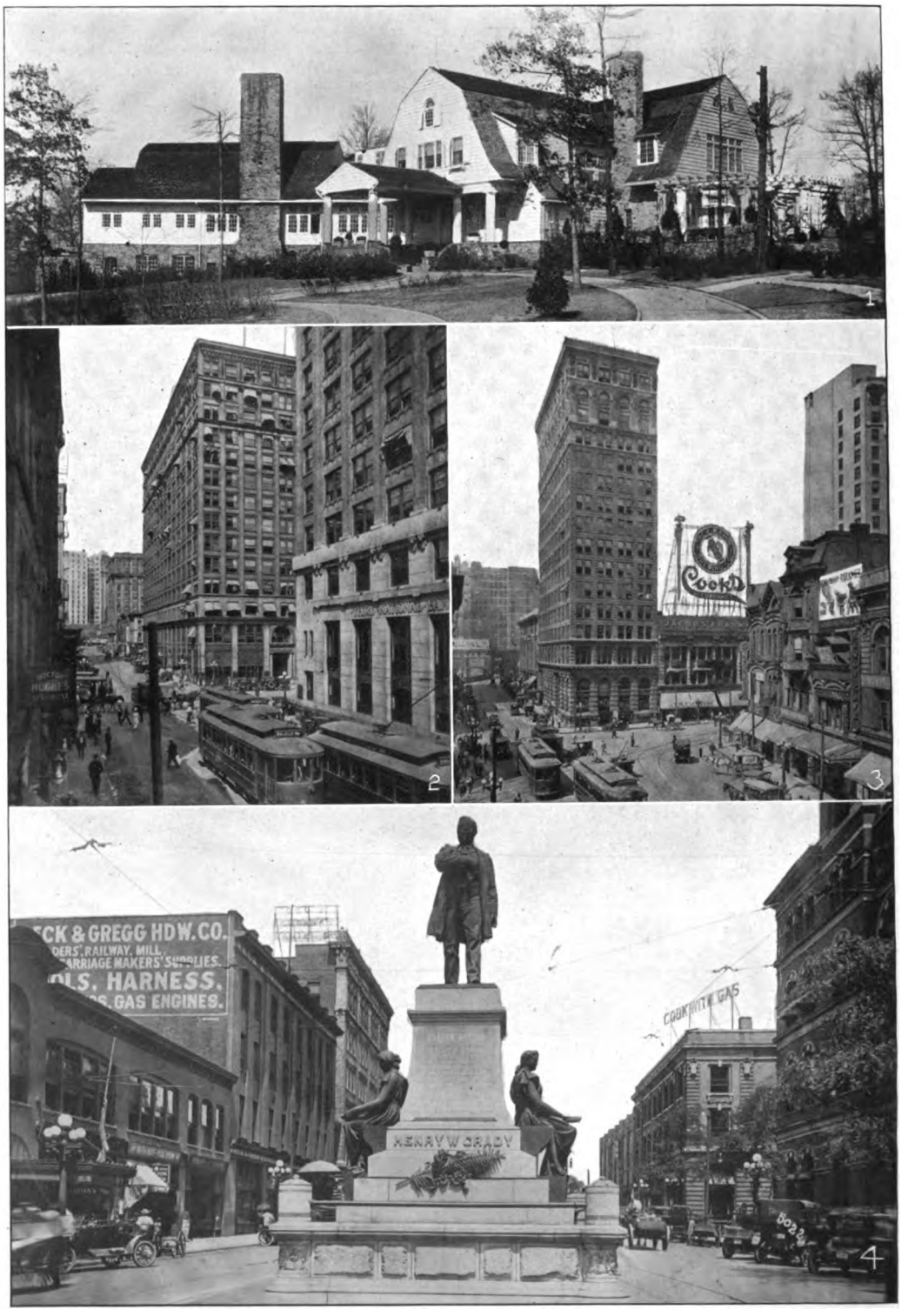


CARNEGIE LIBRARY



GEORGIA SCHOOL OF TECHNOLOGY

ATLANTA, GA.



1 Club House of the Druid Hills Golf Club
2 View of Broad Street, looking North from Marietta Street
3 View of Five Points, the Centre of Atlanta
4 Statue of Henry W. Grady

Commerce, Clearing House Association, Credit Men's Association, Manufacturers' Association and Freight Bureau are organs for concerted action among business men. The Greater Georgia Association, projected by the Atlanta Chamber of Commerce, unites the efforts of Georgia towns, cities and counties to develop the resources of the State. Fraternal and social organizations are numerous and active. Religious denominations are well organized. The public school system comprises grammar schools and high schools, with over 26,000 pupils, three business colleges have 1,500 students, medical and dental colleges have 1,500. Two male colleges, a female seminary and several select schools for boys have an attendance of 2,500. The Georgia Institute of Technology with 900 students is the most important institution for higher education. It has textile, mechanical engineering and electrical engineering schools and machine-shop practice in addition to literary and scientific courses. The total number of students in the city in higher institutions for white youths and girls is about 7,000. A site has been donated and funds are partially raised for the Oglethorpe (Presbyterian) University, the total investment of which is estimated at $1,000,000. Emory (Methodist) University is also being established with funds already acquired, amounting to $3,000,000.

There are six institutions for the higher education of colored youth, with a total attendance of 3,000. They include literary and scientific schools, theology, industrial training and a training school for nurses. Charities are numerous and include such educational features as free kindergartens, night schools and three orphan asylums. Grady Hospital is supported by the city; Saint Joseph's Infirmary by the Roman Catholics, and the Presbyterian Hospital by the Presbyterians. Private hospitals or sanatoriums are numerous and well equipped. There are two theatres with 2,500 and 2,000 seating capacity, and two lyceum or lecture associations. Carnegie Library is a white marble building in classic style, and contains over 40,000 volumes. The book circulation is over 150,000, one-fourth among juveniles. There are 264 churches, including missions, and the attendance is made up of a fair proportion of all of the population. The total membership exceeds a third of the population. Atlanta was an important strategic point in the Civil War. In 1861 it became a depot of Confederate military supplies, and this made it an objective point in General Sherman's march to the sea. After a siege of several weeks he occupied the city (see JONESBORO, BATTLE OF, AND FALL OF ATLANTA), and by his order it was burned 17 Nov. 1864. In later years General Sherman described the strategic position of Atlanta by comparing it to the wrist of a hand whose fingers reached the five principal ports of the gulf and south Atlantic coast. Twice the test of war has approved the site, and twice a city has been built on the same spot. In 1865 the military government of Georgia was established there. During the Spanish War the city was, and still is, headquarters for the Department of the Gulf. From 39,000 in 1880 the population grew to 89,872 in 1900. The census of 1910 showed the population to be 154,485, an increase of 72.3 per cent as against a 37.1 per cent increase from 1880 to 1890. The present population (1917) is conservatively estimated at 205,000.

WALTER G. COOPER,
Secretary Chamber of Commerce.

ATLANTA UNIVERSITY, a coeducational (non-sectarian) institution for negroes, in Atlanta, Ga., organized in 1869. In 1913 it had 34 officers and instructors, 404 students, 15,000 volumes in the library, grounds and buildings valued at $285,000, and an endowment of $100,000.

ATLANTES, ăt'-lăn'tēz, in architecture, colossal statues of men used instead of pillars to support an entablature. Roman architects called them *telamones* (Greek).

ATLANTIC, Iowa, city and county-seat of Cass County, situated on East Nishnabatna River and on the Chicago, R. I. & P. Railroad, 80 miles southwest of Des Moines. It has various manufacturing interests, including iron and bridge works, planing mills, canning factories, starch-works, soap-factory, two machine shops, and operates municipal water works and electric lighting plants. It was chartered as a city in 1869. Pop. (1910) 4,560; (1916) 6,000.

ATLANTIC CITY, N. J., city and popular seaside resort in Atlantic County; on the Atlantic Ocean and on the Reading and the Pennsylvania railroads, 60 miles southeast of Philadelphia and 136 miles southwest of New York. It is built on a long, sandy island, known as Absecon Beach, which stretches along the coast for 10 miles; has an average width of three-fourths of a mile and is from four to five miles from the mainland. At the north end is the Absecon Light, 160 feet high, well-known to coastwise sailors. The city has several miles of bathing beach, six great recreation piers, a magnificent promenade — the famous "Board Walk" of steel and concrete, covered with board flooring, eight miles long,— on the ocean front, nearly 100 hotels and boarding-houses, electric lights, municipal water works, public schools, churches of the principal denominations, seven national banks, and daily, weekly and monthly periodicals. It is probably the most important all-the-year-round resort in the United States, its splendid climate giving it a large popular patronage even in the dead of winter. About 100,000 persons bathe daily in the height of the summer season. The assessed property valuation exceeds $59,000,000. A fire in April 1902 destroyed many hotels and other buildings and led to a municipal enactment that all structures henceforth erected within the municipal limits must be fireproof. While not known as a manufacturing city, the United States census recorded 105 manufacturing establishments of factory grade, employing 1,230 persons, of whom 917 were wage earners, receiving $614,000 annually in wages. The capital invested aggregated $7,050,000, and the value of the year's output was $2,908,000; of this, $1,556,000 was the value added by manufacture. Atlantic City was first settled in 1854 on the site of a fishing settlement dating from 1780. It is governed, subject to referendum and recall, by five commissioners, elected every four years. Pop. 44,461; in summer, about 350,000.

ATLANTIC COAST LINE RAILROAD COMPANY, The. A railway system extending from Richmond, Va., to Port Tampa, Fla.,

a trunk line distance of 900 miles, with many auxiliaries and branches. On 30 June 1916 the system was operating 4,773.66 miles of road, of which 52.17 miles were operated under lease, and 53.79 miles under trackage rights. The Company also owned several small branches (totalling 16.83 miles) which it did not operate.

The Atlantic Coast Line Railroad Company had its beginning in the Richmond & Petersburg Railroad Company chartered by the State of Virginia in 1836. In 1900 the name was changed to The Atlantic Coast Line Railroad Company of Virginia. Later in that year the Norfolk & Carolina Railroad, the Wilmington & Weldon Railroad, the South Eastern Railroad and the Atlantic Coast Line Railroad of South Carolina were consolidated with it, and the name was again changed to its present title.

The Company's operating revenues for the fiscal year ended 30 June 1916 were $34,445,110; earned by the transportation of 7,850,394 passengers and 12,291,713 tons of freight. The passenger travel averaged 48.07 miles per person, at a charge of 2.192 cents per mile — aggregating in the year 377,368,440 passenger miles, and $8,271,629. The freight traffic averaged 167.08 miles per ton, at a charge of 1.835 cents per ton-mile — aggregating in the year 10,296,523,340 ton-miles, and $23,292,589. The operating expenses for the year were $22,797,008. After deducting taxes and bills uncollectible, the total operating income was $9,838,805. A dividend income of $2,386,447 and other non-operating income increased the gross income to $13,975,955. The interest paid on the funded debt amounted to $5,846,656, and this, with other miscellaneous deductions, reduced the net income to $7,755,536. Of this, $140,551 was appropriated for physical betterments and $7,598,893 was transferred to profit-and-loss account. The operating revenue per mile of road was $7,324 and the operating expenses $4,847; making the net operating revenue per mile of road $2,476.

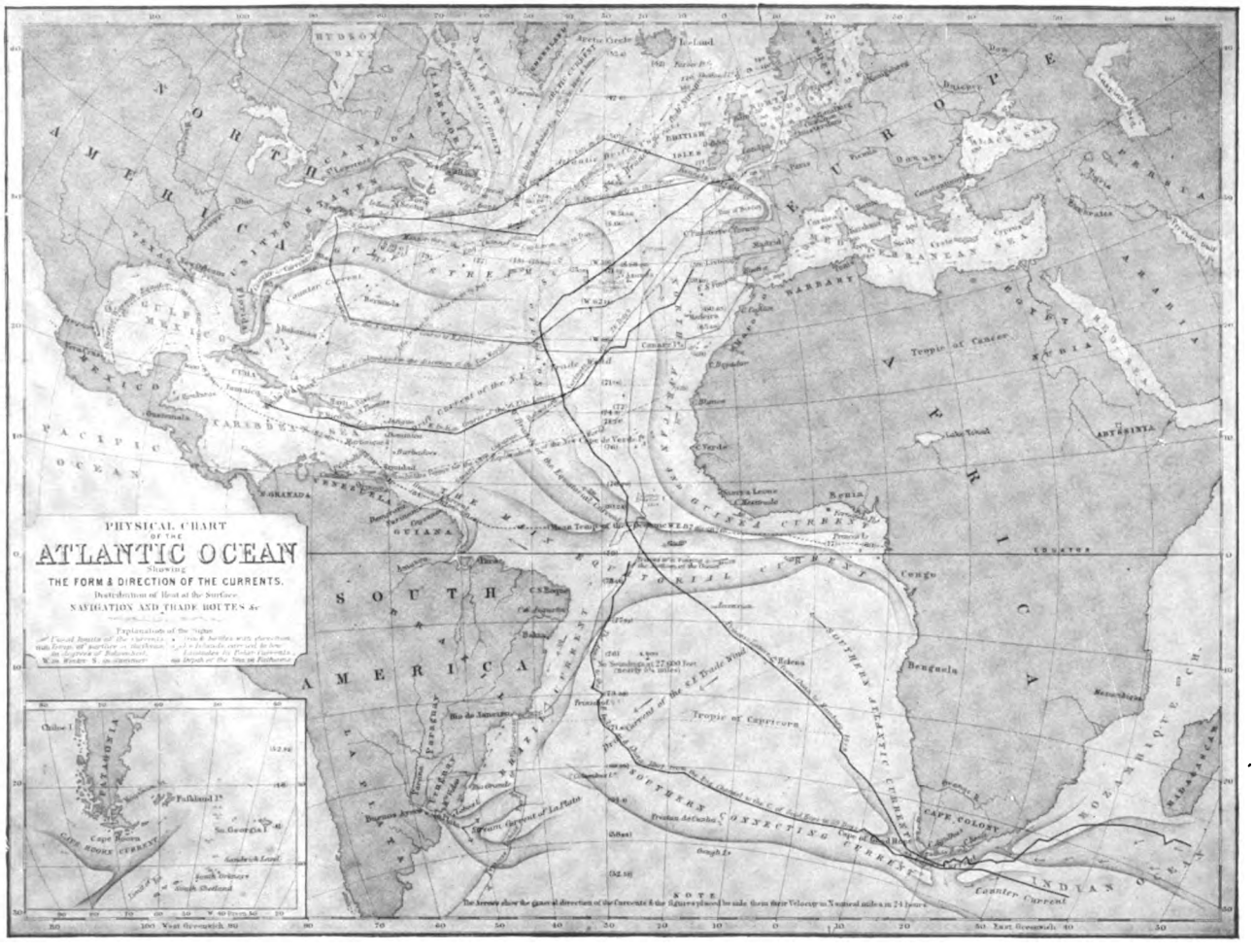
The equipment of the road on 30 June 1916 consisted of 820 locomotives, with an aggregate tractive capacity of 18,411,700 pounds; 353 passenger coaches; and 28,313 freight cars — of which 635 were coal cars with an aggregate capacity of 25,400 tons. The largest item of freight carried on the road is lumber, amounting to 2,658,210 tons. Following this in tonnage are mining products, including 683,470 tons of bituminous coal, amounting to 2,104,921 tons; forest products not included under lumber, 1,748,292 tons; and cotton, fruit and vegetables, with other agricultural products, 1,697,912 tons.

The entire investment in the road and its equipment on 30 June 1916 was $178,568,333. Investments of the Company in affiliated companies amounted to $60,432,922; and other investments totaled $3,193,230. The stock outstanding on the date named was $73,574,272 (out of $100,000,000 authorized), and the total long term debt was $138,777,635. The credit balance of the profit-and-loss account was $33,583,626. The Company owns a majority of the capital stock of the Louisville & Nashville Railroad Company, and with the latter jointly leases the Georgia Railroad and its dependencies, covering 591 miles. The Atlantic Coast Line Railroad Company is affiliated with the Atlantic Coast Line Company, a security-holding corporation which owns $18,413,600 of the stock of the railroad company.

ATLANTIC HIGHLANDS, N. J., borough and summer resort of Monmouth County, 20 miles south of Jersey City, on Sandy Hook Bay, and on the Central Railroad of New Jersey. There are the usual resort amusements, yacht and tennis clubs, a casino, and very many residences, hotels and boarding-houses. The waterworks and electric-lighting plants are the property of the borough. Pop. 1,645.

ATLANTIC OCEAN, the body of water lying between the eastern coasts of the Americas and the western coasts of Europe and Africa, and extending from the Arctic Basin to the Great Southern Ocean. Its greatest breadth, attained in lat. 25° N., is 4,500 miles; but between Cape S. Roque in Brazil and Cape Palmas its breadth is only 1,600 miles. Its superficial extent, not including the inland seas, is approximately 23,215,000 square miles, or 10,588,000 square miles in the north Atlantic Ocean and 12,627,000 square miles in the south Atlantic. The mean depth of the north Atlantic is 2,047 fathoms; of the south Atlantic 2,067 fathoms.

Chief Distinguishing Characteristics.— A preliminary and strictly condensed statement may serve, in some slight degree, to characterize this ocean and to differentiate it from the others. In the following respects, then, if we limit the number of particulars to a dozen, the Atlantic seems to be most clearly differentiated: (1) It has a much larger drainage area than either the Indian Ocean or the Pacific Ocean. (2) That portion of the Atlantic Ocean lying north of the equator and known as the north Atlantic has been more carefully studied than the other main divisions of the hydrosphere; and the interest manifested in this way is partly due to the number and exceptional importance of the enclosed seas connected with it. (3) The Atlantic Basin has, as the dominant feature of its relief, a submarine ridge that extends, approximately, from lat. 50° N. to lat. 40° S. and divides the basin into the eastern and western submarine valleys or troughs. (4) The number of islands in the Atlantic is relatively small — particularly small in the south Atlantic. (5) The basin of the Atlantic Ocean was formed in comparatively recent geologic time. It dates probably from the Mesozoic age, whereas the Pacific Ocean's basin is of truly great antiquity. (6) The salinity of the Atlantic far exceeds that of the other great oceans; it is especially marked in its great inland sea, the Mediterranean, and increases as we proceed toward the eastern part of that sea. (7) As compared with the wind circulation over the other great oceans, that over the Atlantic has a very definite character. (We shall refer to this subject again in connection with the formation of drifts and currents). (8) The Atlantic contains the Gulf stream, which probably exceeds in volume and in rapidity all other stream currents in the world. (9) Between lat. 20° N. and 35° N. and long. 40° W. and 75° W. there is a distinctively Atlantic area in which there is practically no surface circulation and which — owing to the circumstance that it is covered by enormous banks of gulf-weed (*Sargassum*


PHYSICAL CHART
OF THE
ATLANTIC OCEAN
Shewing
THE FORM & DIRECTION OF THE CURRENTS.
Distribution of Heat at the Surface.
NAVIGATION AND TRADE ROUTES &c
NORTH AMERICA
SOUTH AMERICA
EUROPE
AFRICA
Tropic of Cancer
Tropic of Capricorn
Equator
GULF STREAM
CANARY CURRENT
GUINEA CURRENT
BRAZIL CURRENT
SOUTHERN CONNECTING CURRENT
BENGUELA CURRENT
INDIAN OCEAN
PACIFIC OCEAN
MEDITERRANEAN SEA
Falkland I.s
Cape Horn
Sandwich Land
South Orkneys
South Shetland
Chiloe I.
PATAGONIA
CAPE COLONY
Congo
Benguela
ABYSSINIA
ARABIA
NUBIA
Guinea
Sierra Leone
Bermudas
Jamaica
Barbadoes
Trinidad
Madeira
Canaries
C. Verde
Azores
Iceland
Ireland
Labrador
Greenland
Hudson Bay
Newfoundland
Terra Nova
Cape Horn Current
Brazil Current
Southern Connecting Current
Benguela Current
Guinea Current
Canary Current
Gulf Stream
Indian Ocean
Mozambique Ch.
Madagascar
Rio de Janeiro
Buenos Ayres
Cape Town
Algoa Bay
Natal
Mauritius
Bombay
Calcutta
Madras
Ceylon
Java
Sumatra
Australia
New Holland
Van Diemens Land
New Zealand
Japan
China
Kamtschatka
Behring's Straits
Aleutian Islands
Sandwich Islands
Otaheite
Marquesas Islands
Society Islands
Friendly Islands
New Caledonia
New Hebrides
Solomon Islands
New Britain
New Ireland
Admiralty Islands
Caroline Islands
Ladrone Islands
Philippine Islands
Moluccas
Celebes
Borneo
Timor
Java Head
Sunda Strait
Straits of Malacca
Straits of Sunda
Straits of Banca
Straits of Gaspar
Straits of Timor
Straits of Lombock
Straits of Macassar
Straits of Bali
Straits of Sumbawa
Straits of Flores
Straits of Ombay
Straits of Pentland
Straits of Torres
Straits of Magellan
Straits of Le Maire
Straits of Dover
Straits of Gibraltar
Straits of Bab-el-Mandeb
Straits of Ormuz
Straits of Babelmandel
Straits of Sunda
Straits of Banca
Straits of Gaspar
Straits of Timor
Straits of Lombock
Straits of Macassar
Straits of Bali
Straits of Sumbawa
Straits of Flores
Straits of Ombay
Straits of Pentland
Straits of Torres
Straits of Magellan
Straits of Le Maire
Straits of Dover
Straits of Gibraltar
Straits of Bab-el-Mandeb
Straits of Ormuz
Straits of Babelmandel

bucciferum — has received the name Sargasso Sea. (10) Between South America and Africa, a secondary tidal-wave moves northward; and this is produced by, or perhaps deflected from, the east-to-west tidal-wave of the Southern Ocean. (11) Ice formations of the north Atlantic are noticeably different in character from those of the north Pacific. (12) The entire Atlantic, vast though it is, may be called simply the greatest of inland seas, rather than a true ocean. (The reasons for this will be mentioned in the paragraph *Fauna*).

Islands and Enclosed Seas.— The principal oceanic islands are the Canaries, Azores, Cape Verde Islands, Madeira, Ascension, Saint Helena, Bouvet Island and Tristan da Cunha; while those classed as continental groups are the British Isles, West Indies, Iceland, Newfoundland and the Falklands. Connected with the Atlantic are, on the eastern side, the Mediterranean and the Black Sea, the North Sea and the Baltic; on the western side are the Gulf of Mexico and the Caribbean Sea (together forming the American Mediterranean), Hudson Bay and the Gulf of Saint Lawrence.

Winds and Currents.— Of the winds of the Atlantic, the most remarkable are (1) the perennial or trade winds which blow constantly in one direction, or nearly so — from east to west, southeast to northwest, or northeast to southwest, and (2) the so-called "roaring forties." The region of the trade winds north of the equator is known as the zone of the northeast trades; that south of the equator as the region of the southeast trades. The northeast trade wind blows with less steadiness than the southeast; in the West Indies, however, the former seldom forsakes its regular course. Both are found to be most constant when the observations are taken far out at sea; less steady on the land or near it. Commander W. W. Campbell Hepworth has written (in the *Geographical Journal*, November 1914, Vol. XLIV, No. 5): "The northeast and southeast drift-currents, following the course of the wind, gradually turn more and more to the eastward [as the source, not the direction of their movement], and increase in volume, in breadth and depth as they flow toward the equator until they unite and form the Equatorial Current. For convenience, the northern portion of this great ocean river, which owes its origin mainly to the northeast trade wind, is called the North Equatorial Current, while the southern portion, which is derived mainly from the southeast trade wind drift-current, is called the South Equatorial Current; but there is in fact no definite dividing line, except that during the six months of the year, June to November, the heaped-up waters of the two currents overflow between the third and 13th parallels of north latitude, east of about the 50th meridian, and turn to the eastward, thus becoming a counter current, which subsequently joins a southeastward setting branch of the northeast trade wind drift-current and a northeastward setting branch of the southeast trade wind drift-current, when the combined current flows eastward, immediately south of and parallel to the Guinea Coast." The Gulf Stream is a continuation, partly of the main and partly of the north equatorial currents, which pass across the Atlantic to the South American coast. That portion of the ocean river deflected northward then runs along the coast until it enters the American Mediterranean; receiving later the name of Gulf Stream when (and because) it issues, between Florida and Cuba, from the Gulf of Mexico. It afterward flows nearly parallel to the coast of the United States, separated from it by a belt of cold water. Off Cape Hatteras it attains a width of 167 miles and comprises three warm sections with two cold belts interposed. On passing Sandy Hook it turns eastward and continues to be recognizable, partly by its characteristic blue color, until it reaches long. 30° W., where, with diminished temperature, it is found flowing nearly due east. The warm drift from it that reaches the coasts of the British Isles represents, not the Gulf Stream proper, but a side branch, which derives its impetus from the southwest winds of those latitudes. There is, none the less, a real connection between the two. The Brazil Current is formed by that portion of the equatorial ocean river which is turned southward from Cape S. Roque in South America. The South African current originates near the Cape of Good Hope and flows in a northwesterly direction, eventually uniting with the equatorial currents. The Cape Horn current flows from the Southern into the Atlantic Ocean, its general direction being east-northeast. Rennel current, a drift from the Gulf Stream, enters the Bay of Biscay from the west. The Arctic current runs along the east coast of Greenland and continues along the coast of the United States, from which it separates the Gulf Stream by a band of cold water. An Antarctic current of cold water — not at the surface, like the foregoing, but at a great depth — flows from Antarctic regions toward the equator.

Fauna.— The suggestion has been made by several geologists that the Atlantic is not a true ocean like the Pacific, but rather a basin of secondary formation and comparatively recent origin. Moreover it has been shown that, meteorologically, the Atlantic should be considered as an inland sea — not a true ocean. Mr. Austin H. Clark has recently discussed the same matter from the biological standpoint. We premise that an inland sea is, biologically speaking, a more or less enclosed body of water that is connected with an ocean and has received all of its fauna from that ocean. Its fauna is therefore composed of the same types that occur in the ocean with which it is connected, except that the less plastic and adaptable types may have been eliminated and the remainder modified in proportion to the difference between the physical and chemical conditions of the inland sea and that of the parent ocean. After a protracted statement of the evidence, Mr. Clark concludes: "Thus we are justified in assuming that, so far as the evidence to be deduced from the study of the recent crinoids permits us to judge, the Atlantic Ocean is biologically, as it is geologically and oceanographically, an inland sea, for it has received its entire fauna from outside, by means of four different routes, only two of which are now open, and has never originated any type within its own basin. Furthermore it is an inland sea largely, if not entirely, formed through the unequal subsidence of a land mass;

for the fauna of the Caribbean region, composed of ancient and generalized types, appears to have become established before the intrusion of the species from the Mediterranean region, which are more modern and more specialized, became possible.»

Depths.—The most profound depression yet discovered in the Atlantic is the «deep,» north of Porto Rico, measured by scientists of the coast survey steamer *Blake* (4,561 fathoms or 27,366 feet—708 fathoms less than that given by soundings near Guam in the Pacific). Recurring now to the two great undersea valleys or troughs we have mentioned, we note that the mean depth of the east valley is about 14,000 or 15,000 feet, while the maximum depth of the west valley or trough is 16,800 feet. The submarine ridge separating these troughs is submerged to a depth of 1,600 fathoms from the Azores to the latitude of the Hebrides. It then rises gradually, emerging and culminating in Iceland. The south Atlantic has a slightly greater average depth than the north Atlantic.

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MARRION WILCOX.

ATLANTIC SEABOARD DIFFERENTIALS. See DIFFERENTIALS IN RAILROAD TRAFFIC.

ATLANTIC TELEGRAPH. See TELEGRAPH.

ATLANTICO, Colombia, the smallest of the departments of the republic, bounded on the north and northwest by the Caribbean Sea, on the east by Magdalena and on the south and southwest by Bolivar. Area 1,082 square miles; capital Barranquilla. Its provinces are Barranquilla and Sabanalarga. Its plains, sloping to the Magdalena River or to the Caribbean Sea, are of value as pastures for cattle and also for the cultivation of tropical fruits, etc. There are 67 primary schools in the department, with 4,273 pupils (3.71 per cent of total population), and the school budget is about 15.54 per cent of the entire departmental budget. Pop. 116,000.

ATLANTIDA, a department of Honduras, Central America, established in 1902. It is bounded on the north by the Caribbean Sea and Gulf of Honduras, on the east by the department of Colón, on the south by Yoro, and on the west by Cortés. It embraces the municipalities of La Ceiba (the capital, with 6,000 inhabitants), Tela, El Porvenir, San Cristóbal and San Francisco. Chief elevation, the Cerro de Bonito (5,900 feet); capes, Cangrejal, Hisopo, Papaloteca, Salado and Ulua; rivers, the Ulua, the Colorado, the Cuero, Bonito and Bonitillo; products, cocoa, coffee, sugar, aguacates, oranges, lemons, pineapples, and all sorts of vegetables. Pop. 20,000.

ATLANTIDES, a name given to the Pleiades, the seven daughters of Atlas or of his brother Hesperus.

ATLANTIS, or **ATLANTICA,** a large island traditionally asserted to have once existed in the ocean immediately beyond the Strait of Gades; that is, in what is now called the Atlantic Ocean, a short distance west of the Strait of Gibraltar. Homer, Horace and some others made two Atlanticas, distinguished as the Hesperides and the Elysian Fields, and believed to be the abodes of the blessed. Plato states that an easy passage existed from the one Atlantis into other islands, which lay near a continent exceeding in size all Europe and Asia. Some have thought this America. Atlantis is represented as having ultimately sunk beneath the waves, leaving only isolated rocks and shoals in its place. Geologists have discovered that the coast line of western Europe did once run farther in the direction of America than now; but its submergence seems to have taken place long before historic times. Plato's accounts in his 'Timæus' and 'Critias' are considered a pure invention by some, but very many regard them as real tradition. 'The New Atlantis' is the title which Lord Bacon gives to a literary fragment, in which he sketched out an ideal commonwealth. Consult Steiner, 'Submerged Continents of Atlantis and Lemuria' (Chicago 1911) and Volquardsen, 'Ueber die Mythen bei Plato' (Schleswig 1871).

ATLAS, an anatomical term applied to the first vertebra of the neck, which supports the head. It is connected with the occipital bone in such a way as to permit of the nodding movement of the head, and rests on the second vertebra or *axis*, their union allowing the head to turn from side to side.

ATLAS, in Greek mythology, the Titan whom Zeus condemned to bear the vault of heaven. The same name is given to a collection of maps and charts, and was first used by Gerard Mercator in the 16th century, the figure of Atlas bearing the globe being represented on the titlepages of such works.

ATLAS, an extensive mountain system in north Africa, starting near Cape Nun, on the Atlantic Ocean, traversing Morocco, Algiers and Tunis, and terminating on the coast of the Mediterranean. It is divided into the Moroccan, or western, and the Algerian, or eastern, Atlas. The western group is divided into the great Atlas, the little Atlas on the Mediterranean coast, and the anti-Atlas, southwest of the great Atlas and near the Atlantic coast. The great Atlas contains the highest peaks of the whole system, Jebel Ayashin (14,600 feet) and Tamjurt (14,500 feet). On the coast, the range skirts the Mediterranean, from Cape Spartel, and the Straits of Gibraltar, to Cape Bon, on the northeast of Tunis. The Atlantic shore is sometimes sandy and low, at other times formed by cliffs, which do not attain any great height, except at Cape Ghir. The Mediter-

ranean shore, between Capes Spartel and Bon, is generally rugged, and in places attains a considerable height. Between Cape Bon and the Gulf of Gabes it is rocky, but without reaching any great elevation. The southern slope of the Atlas reaches the great desert, from which it is separated by a region of sand hills, shifting with every strong wind, and gradually making encroachments on the fertile lands at the foot of the mountains. On the west of the Gulf of Gabes, Mount Nofusa, the last eastern spur of the Atlas, joins Mount Garian, which extends into Tripoli. The French geographers include within the limits of the Atlas their own province of Algeria, together with Morocco, and a part of Tunis. The rocks of the system are igneous and sedimentary of the Archæan and Paleozoic periods. There are also many Jurassic and Tertiary formations. Copper, iron, marble and salt are found. While snow remains on the higher peaks during the greater part of the year no peak has a perpetual cover of snow. The whole area is 500,000 square miles, including a great variety of surface, mountains, valleys and extensive plains. The valleys are very fertile, are nearly all under cultivation and compare most favorably with other Mediterranean regions. Consult Fischer, T., "Ueber meine Reise im Marokkanischen Atlas," in *Zeitschrift der Gesellschaft für Erdkunde* (Vol. XXVI, Berlin 1899); Gentil, Louis, 'Mission de Sagonzac' (Paris 1906); Schnell, P., 'L'Atlas marocain' (Paris 1898); Thomson, Joseph, 'Travels in the Atlas and Southern Morocco' (London 1889).

ATLAS POWDER, highly explosive dynamite used in mining, quarrying, tunneling, shaft and well sinking, submarine blasting, road building, in farming to remove tree stumps or boulders from land, and subsoiling. It is composed of nitroglycerin, sodium nitrate, wood pulp, and a small quantity of some anti-acid, as chalk, etc. For special requirements as to strength and destructive potentiality the proportions of the ingredients are varied. When not confined it will burn harmlessly, but when fired by a detonating cap it explodes with enormous force. It is put up in cartridges about 8 inches long and from seven-eighths to two inches in diameter, containing from 25 to 75 per cent of nitroglycerin, according to the use to which it is to be put. See EXPLOSIVES.

ATLEE, Washington Lemuel, American surgeon: b. Lancaster, Pa., 22 Feb. 1808; d. 6 Sept. 1878. He became noted as a pioneer in ovariotomy and the removal of uterine fibroid tumors, and published 'Ovarian Tumors' (1873), 'Struggles and Triumphs of Ovariotomy' (1875), and a prize essay on 'Fibroid Tumors of the Uterus' (1876).

ATMIDOMETER, an instrument for measuring the evaporation from water, ice, snow, etc. It consists of two glass or metal bulbs, one of them placed above the other, with which it communicates by a narrow neck. The instrument having been immersed in a vessel of water through a circular hole in which the steam rises, distilled water is gradually poured into the pan above, causing it to sink to the point at which the zero of the stem is on a level with the cover of the vessel. As then the water in the pan gradually evaporates, the steam slowly ascends, the amount of evaporation being indicated in grains on the graduated scale.

ATMOL'YSIS, the separation of the components of a gaseous mixture by means of diffusion. See DIFFUSION.

ATMOGRAPH, an instrument recording water evaporation. See ATMOMETER.

ATMOMETER, an instrument for measuring the quantity of moisture exhaled in the open air in a given time from any moist surface, or from the surface of a liquid. The first instrument of this kind was invented by Sir John Leslie. It consisted of a very thin ball of porous earthenware, from one to three inches in diameter, having a small neck firmly cemented to a long and rather wide glass tube, to which is fitted a brass cap with a leather collar. It is filled with distilled or pure water and its cap is screwed on tightly. It is then suspended out of doors where it is exposed to the action of the wind but is sheltered from rain. As the water evaporates from the surface of the ball the waste is indicated by a corresponding descent of the water level in the glass tube, accurately measured by a finely-graduated scale. Another form of this instrument consists of a round dish into which is placed an inclined scale, which gives a magnified record of the rate of evaporation from the surface of the liquid in the dish. Sometimes the loss of moisture through evaporation is recorded by means of weighing. The Marvin atmometer consists of a surface of water fed from a supply well where the rate of evaporation can be measured. The Piche instrument is a glass tube, closed on top and open below. The open bottom is then rested on a disc of paper and fastened to it. The water is absorbed by the paper, whence it evaporates, the rate of evaporation being indicated by the descending level in the glass tube as in the Leslie instrument. This instrument, however, is more accurate because of the fact that the paper surface gives off more evaporation than does the exposed surface of the water in an open dish. There is also the balance instrument invented by Wild, in which a pan of water forms the weight on a balance scale, the action of the scale indicating the loss by evaporation. For a detailed description of atmometers consult Russell's 'Meteorology' (New York 1899).

ATMORE, Charles, English Wesleyan clergyman: b. Heacham, 17 Aug. 1759; d. Sheffield, 1 July 1826. He was received into the Wesleyan Church in 1779 by the noted Joseph Pilmoor, one of Mr. Wesley's missionaries to America. In 1781 he met John Wesley and then decided to enter the Wesleyan ministry, and served in various places for nearly 45 years. He was pastor in Glasgow for a time and served in several of the leading English cities. He was author of 'The Methodist Memorial' (1801); 'A Concise History of the Introduction of Methodism in America' (1802); 'The Whole Duty of Man' (1811); 'Familiar Discourses on the Lord's Prayer' (1821), and was the editor of several volumes.

ATMOSPHERE (Greek, "vaporous sphere"), in ordinary usage, the gaseous envelope that surrounds the earth. The atmosphere consists chiefly of the gases, oxygen and nitrogen, not chemically combined, but mechanically mixed in the proportion of about 21 vol-

umes of oxygen to 79 of nitrogen. It also contains small quantities of carbon dioxide, organic matter, water vapor, argon and other substances. (For a more precise statement of its composition, see AIR). At the surface of the earth it has a density of about 1/800th of that of water, though this varies somewhat with the height above the sea-level at which the determination is made, and with the temperature and barometric pressure prevailing at the time. The presence of free nitrogen in the atmosphere may be attributed, probably, to the comparative inertness of that gas, so far as any tendency to form chemical compounds is concerned. The presence of free oxygen cannot be explained in this manner, however, because oxygen is one of the most active chemical substances known. It appears more probable that oxygen is present in the free state simply on account of the immense quantity of that element that the earth contains. In past geological times, it combined with practically all of the oxidizable minerals that were near enough to the surface of the earth to be accessible to it, and the present supply of free oxygen in the atmosphere must be regarded as merely the excess of that element that remained unused, after all the possible oxidations had been effected. According to this view, the earth (at least in its more superficial parts) is a gigantic, burned-out cinder; and this accords with the estimates that chemists and geologists make, that nearly one-half of the weight of the earth's crust consists of oxygen. It is likely that in past ages, and particularly in the carboniferous period when the vegetation that gave rise to our modern coal fields was flourishing, the quantity of carbon dioxide present in the atmosphere was considerably greater than at the present time. Part of this gas was absorbed by plants, its carbon being stored in the coal beds and its oxygen returned to the air; but it is likely that by far the greater portion combined with lime and other similar earths to produce the present vast deposits of limestone and other carbonated minerals and rocks. At the present day, carbon dioxide is being absorbed from the atmosphere by plants, and returned to it again by animals, and by factories in which coal is burned. We have no means of knowing whether the balance is being preserved, so far as this constituent of the atmosphere is concerned, or not, because the mass of the entire atmosphere is too vast for the composition to be sensibly changed by these causes, since the time when exact analyses became possible.

Galileo observed that water cannot be drawn up by a suction pump, or other equivalent device, to a greater distance than about 34 feet. He did not succeed in explaining the existence of this limiting height, but his friend and amanuensis, Torricelli, who succeeded him as professor at Florence, afterward made the shrewd guess that water rises in such a pump for the reason that the atmosphere exerts a certain pressure upon all terrestrial objects, and that when a portion of this pressure is removed from the water in the suction tube of the pump, it is the pressure of the atmosphere upon the water *external* to the pump that causes the water in the pump-tube to rise; and he saw that if that were the case, it would follow that a pump could only draw» water up to the particular height at which the pressure due to the water-column so «drawn up» would precisely balance that of the atmosphere. The limit of 34 feet corresponds (as is easily shown by a simple calculation) to a pressure of about 15 pounds to the square inch; and hence Torricelli inferred that the atmosphere exerts a pressure of that amount upon all objects. Mediating upon this hypothesis, it occurred to him that if his explanation were indeed correct, the atmosphere would be able to raise mercury (which is about 14 times as heavy as water) to only about one-fourteenth of the height to which it can raise water. He accordingly (in 1643) procured a glass tube some 35 inches long, and closed at one end. Placing it with the open end upward, he filled it with mercury. He then covered the open end to prevent the escape of the mercury and inverted the tube so that its mouth dipped into a basin also filled with mercury. Upon uncovering the open end of the tube, he was gratified to see that the mercury in the tube at once sank until its upper surface stood at about 30 inches above that in the basin. This experiment proved that the atmosphere exerts a pressure equal to that due to a column of mercury 30 inches high; or, in other words, equal to about 14.7 pounds per square inch. Additional proofs were soon given, also. Thus Pascal suggested that if the explanation were true, the pressure ought to be less at the top of a mountain, than in a lower place; because the mountain projects up into the atmosphere so far that there is a sensibly smaller height of air above it than there is above a point in a valley. The experiment was actually carried out by M. Perrier, who carried an apparatus like Torricelli's (now known as a «barometer») to the summit of a mountain in Auvergne called the Puy de Dôme, and found at the top of this mountain (which is 4,800 feet high) the atmosphere could sustain only about 27 inches of mercury, although after returning to the plains below, the full height of 30 inches was again observed. Shortly afterward (in 1650) the air-pump was invented by Guericke, and the pressure of the atmosphere was demonstrated beyond any doubt whatever, by numerous direct experiments.

The pressure of the atmosphere varies somewhat from day to day, and even from hour to hour, as well as with the latitude and with the height above the sea. For scientific purposes the normal atmospheric pressure is now generally taken to be equal to the pressure due to a column of pure mercury, 760 millimetres (29.9212 inches) high, at the level of the sea, in latitude 45°; the mercury being at the temperature 32° F. The pressure so defined is called an «atmosphere»; or, more briefly and conveniently, an «atmo.» The «atmosphere» of pressure, as so defined, is nearly equal to a pressure of 1,000,000 dynes per square centimetre, and it has therefore been proposed to take 1,000,000 dynes per square centimetre as the standard atmosphere of pressure, calling it an «absolute atmosphere,» because the dyne is a unit in the «absolute system» of units. This proposal has not yet been adopted by physicists to any great extent. See UNITS.

Knowing the pressure exerted by the atmosphere upon each square inch of the earth's surface to be about 14.7 pounds, and knowing the dimensions of the earth, it is not difficult to calculate the total weight of the entire atmos-

phere. The calculation, when performed, shows that the mass of the atmosphere is about 1/1,000,000th of that of the whole earth.

If the atmosphere were of uniform density, it would be easy to calculate the height to which it extends. We should only have to divide the pressure upon one square inch of the earth's surface by the weight of a cubic inch of the air, and the quotient would be the height of the atmosphere, in inches. Thus a cubic inch of air, at a pressure of 30 inches of mercury and at the temperature of freezing water, weighs about 0.000749 of an ounce; and as a column of mercury 30 inches high exerts a static pressure of about 235.8 ounces, it follows that if the atmosphere were homogeneous (that is, of uniform density throughout), its height would be about $253.8 \div 0.000749 =$ 314,000 inches, or 4.97 miles, when the air has a temperature of 32° F., and the barometric pressure is 30 inches. The height so calculated is convenient for use in certain physical computations, and is called the "height of the homogeneous atmosphere." If we turn from this problem to the more difficult one of determining the *actual* height of the atmosphere, we find that no satisfactory results can be given. As we go up, the strata become rarer and rarer, for the reason that the lower layers are weighed down and compressed by those above, and at increasing heights there is less and less air above, to exert this compression. At great heights the atmosphere becomes more and more attenuated, and thins out by insensible gradations into a perfect vacuum. There is no definite boundary, immediately below which there is an atmosphere, and immediately above which there is none. Glaisher and Coxwell, in their famous balloon ascension of 5 Sept. 1862, attained an actual elevation of over 29,000 feet, and observed a barometric height of 9.5 inches (corrected); but it is certain that the atmosphere extends far higher than this. Some estimates, based on the calculated heights of shooting stars when they first become luminous, place the limit at which the atmosphere has a density sufficient to produce any observable effects at about 200 miles; but, as has been pointed out above, all estimates of this kind are necessarily indefinite and unsatisfying. (For some of the questions raised in connection with the limits of the atmosphere, see GASES, KINETIC THEORY OF).

The atmosphere, as might be expected from its relatively great depth, exhibits an absorption spectrum (see SPECTROSCOPE), and this varies to a certain extent from time to time. A portion of this absorption spectrum is due to the presence of water vapor, and the "rain bands" in the spectrum have been utilized to a limited extent (though not very generally) in connection with weather predictions. It is also known that the atmosphere is less transparent to the rays at the blue end of the spectrum than to those in the middle and toward the red end. The experiments of Prof. S. P. Langley, on the expedition of the United States Signal Service to Mount Whitney, demonstrated that this selective absorption is so great that the sun would appear distinctly bluish, instead of white or yellowish as it does under actual conditions, if we could see it from a point outside of our own atmosphere. Consult Langley, 'Researches on Solar Heat' (1884).

Little is yet known concerning the electrical phenomena of the atmosphere. In clear, calm weather, the atmosphere appears to be always positively electrified, with respect to the earth, and the difference in potential increases greatly during snowstorms and high winds. In thunder storms it is subject to sudden and violent oscillations, as might be expected. Many theories have been proposed to account for the electrification so observed, particularly for the enormously high potentials that are in evidence during thunder storms; but none has yet met with general acceptance. It was formerly thought that the evaporation and condensation of water had much to do with it, but no experimental evidence has been adduced to justify this hypothesis, although physicists have given it the most careful attention. Bartoli and Pettinelli made exhaustive experiments in connection with it, both with water and with organic compounds; but always without obtaining any favorable results. Kelvin, MacLean and Gall observed electrification when dry air bubbled through a liquid, the air being electrified negatively in the case of pure water, and positively in the case of sulphuric acid or salt water. Apparently these are all friction phenomena, and it is not certain that they have any bearing on the electrical phenomena of the atmosphere. We know, from numerous experiments, that dust facilitates the condensation of aqueous vapor, and numerous authorities have endeavored to trace a similar connection between dust and the development of high electric potentials in the atmosphere. No certain results have been attained, however, as may be judged from the fact that in the 12 years immediately preceding 1902, no less than 25 new thunderstorm theories were proposed, 6 of these being published during the year 1895. See also METEOROLOGY; WIND.

ATMOSPHERIC ENGINE, an early form of pumping engine, invented by Papin in 1695 and subsequently improved by Newcomen and Watt. The steam cylinder is vertical and single acting, the piston being alternately forced upward by steam, and downward by the pressure of the atmosphere.

ATMOSPHERIC LINE. See INDICATOR.

ATOKA, Okla., town and county-seat of Atoka County, on the Missouri, Kansas and Texas Railroad, 110 miles southeast of Oklahoma City, and on the Muddy Boggy River. It contains three banks, five churches, good schools, a stave factory, wagon factory, bottling works, cotton gins, planing mill, steam laundry and an ice plant. Lumbering and farming are the principal interests. The town has an electric-lighting plant and a water works system. Pop. 2,000.

ATOLL, ą-tŏl', the Polynesian name for coral islands of the ringed type enclosing a lagoon in the centre. They are found chiefly in the Pacific in archipelagos, and occasionally are of large size. Suadiva Atoll is 44 miles by 34, and Rimsky 54 by 20. See CORAL ISLANDS.

ATOMIC THEORY, in chemistry, the theory whose fundamental doctrine is that all matter is composed of ultramicroscopic particles, separated by spaces either entirely destitute of matter, or at least containing it in a

very attenuated state. Such a theory was taught by Lucretius and other ancient philosophers, but the views of these early writers were necessarily vague and indefinite, and the atomic theory, as held by chemists of to-day, is generally attributed to the English scientist, John Dalton. In the early part of the 19th century Dalton called attention to the fact that when substances combined chemically they do so in certain definite proportions. His reasoning was something like this: In 100 pounds of carbon monoxide there are 42.9 pounds of carbon, and 57.1 pounds of oxygen. In the same weight of carbon dioxide there are 27.3 pounds of carbon, and 72.7 pounds of oxygen. These are merely experimental facts, obtainable by direct analysis, and they involve no hypothesis whatever. No particular relations are discernable among the numbers stated above; but Dalton discovered that if the same facts are stated in a different way, a very remarkable relation appears. Thus, suppose we calculate what weight of oxygen is combined *with each pound of carbon* in the two gases. In carbon monoxide we find that there are $57.1 \div 42.9 = 1.33$ pounds of oxygen to each pound of carbon, and in carbon dioxide we find that there are $72.7 \div 27.3 = 2.66$ pounds of oxygen to each pound of carbon. One of these numbers being exactly twice the other, we conclude that carbon can unite with oxygen in two proportions, the quantity of oxygen per unit weight of carbon being twice as great in one case as in the other. Dalton observed similar relations among other compounds,—in fact, his theory first occurred to him while he was studying the simpler compounds of carbon and hydrogen; and after turning the matter over in his mind he came to the conclusion that the facts can best be explained by assuming that matter consists of exceedingly minute, indivisible particles or atoms, each of which has a definite weight. When two bodies combine chemically, he conceived their atoms to come together in pairs, or in threes, or fours, according to the compound formed; and he devised symbols to represent the various elementary bodies and their compounds. Thus oxygen was represented by a circle with a white centre, hydrogen by a circle with a dot in the centre, nitrogen by a circle crossed by a vertical straight line, and carbon by a solid black circle. His notation has no advantages over the one now in common use, and hence, in what follows, we shall adopt the modern symbols. As water was the only compound of oxygen and hydrogen that Dalton knew, he naturally represented it by the symbol OH, considering that in it the particles of oxygen and hydrogen are united in *pairs*. Taking the weight of the hydrogen atom as unity, it follows that the weight of the oxygen atom must be 8, if Dalton's view of the composition of water is correct; for experiment shows that in a given mass of water there is eight times as much oxygen, by weight, as there is hydrogen. Carbon monoxide was represented by the symbol OC, and since for each unit of its oxygen (by weight) this gas contains three-fourths of a unit of carbon, it follows that the atomic weight of carbon is three-fourths of that of oxygen. Hence the weight of the carbon atom is 6, the weight of the hydrogen atom being arbitrarily taken, as before, as 1. Carbon dioxide was represented by the symbol OCO. Ammonia gas, being the only compound of hydrogen and nitrogen known to Dalton, was represented by the simple symbol NH; and since experiment shows that ammonia gas contains (by weight) 4⅔ times as much nitrogen as hydrogen, the atomic weight of nitrogen must be 4⅔, or 4.67. In presenting the foregoing sketch of Dalton's views, use has been made of better experimental data than were available in his time, in order that the relation of his system of atomic weights to the modern system may be more clearly seen. A few of his actual determinations of atomic weights, from the imperfect data that he had, are given in the accompanying table. These were published in

Element	Atomic Weight
Hydrogen	1.0
Nitrogen	4.2
Carbon	4.3
Phosphorus	7.2
Oxygen	5.5

1805, and his general theory of chemical compounds was given in the first volume of his 'New System of Chemical Philosophy,' published in 1808. All subsequent researches have tended to confirm Dalton's fundamental conception, that matter is discontinuous in its ultimate nature, and consists of discrete atoms which come together in definite groups when chemical combination occurs. And we agree with him, to-day, in the belief that the so-called "atomic weights" of substances are really the *true relative weights of their atoms;* the weight of the hydrogen atom being taken as unity. Soon after Dalton's theory had been announced, it was observed that there are simple *volumetric* relations among *gases* when they combine. Thus it was noticed that two volumes of hydrogen combine with one volume of oxygen to form water; that one volume of hydrogen combines with one volume of chlorine to form two volumes of hydrochloric acid gas; and so on. This being the fact, it was suggested by Avogadro in 1811, and independently by Ampère in 1813, that all gases, when under the same conditions of temperature and pressure, contain the same number of constituent particles per unit of volume. This principle, known as "Avogadro's Law," has been of the greatest service to chemistry. Its truth was long questioned, but as it has led to results of great value, and has been found to be in conformity with all other known facts of chemistry, it is now accepted without reserve as a fundamental principle of nature. Moreover, the kinetic theory of gases has shown that it is a mathematical necessity, if gases are admitted to consist of elastic particles, flying about through space, and colliding with one another, and with the walls of their containing vessels. (See GASES, KINETIC THEORY OF). But if Avogadro's law be admitted to be a fact of nature, it becomes necessary, at once, to make an important modification in Dalton's theory. For it is plain that if one cubic inch of hydrogen, containing (say) n atoms, combines with one cubic inch of chlorine, also containing n atoms, to produce two cubic inches of hydrochloric acid gas, containing n constituent particles altogether, then the number of such particles

in each cubic inch of the hydrochloric acid gas is only $n \div 2$; whereas Avogadro's law requires us to admit the existence of n particles *per cubic inch*, in the compound gas as well as in each of its constituents. It follows, therefore, that when the H and the Cl combine, their ultimate particles do not simply unite in pairs. There is no way to explain the observed facts, consistently with Avogadro's law, unless we assume that the ultimate particles of H and Cl are both compound, and that when these gases combine, their particles split in two, half a particle of the one combining with half a particle of the other, to produce a whole particle of HCl. In other words, Avogadro's law compels us to admit that the little corpuscles of which matter is composed, and which we have heretofore called atoms, are really (in some cases, at least) systems composed of still smaller bodies. To distinguish between the two kinds of particles — namely, between the systems and their component bodies — it therefore becomes necessary to introduce a new term. The systems are called "molecules" (literally, "tiny masses"), and their constituent parts are still called "atoms." To put the case in another way, the smallest parts into which a given substance can be conceived to be divided, without changing its chemical character, are called "molecules"; while "atom" is reserved for the smallest portion of a substance that can enter into a chemical combination. A molecule is a system of atoms capable of independent existence; and an atom is one of the parts into which the molecule of a substance divides, as a preliminary to entering into a chemical combination.

We have but little information, up to the present time, concerning the number of atoms entering into the molecules of the different elements. The molecules of cadmium, mercury, zinc and indium are believed to be monatomic, at least when those bodies are in the gaseous state; so that in these cases there is no difference between a molecule and an atom. The same is apparently true of argon, helium, neon, krypton and xenon. Hydrogen, nitrogen, oxygen, selenium and tellurium are believed to be diatomic; that is, their molecules are believed to contain two atoms each. Phosphorus and arsenic are believed to be tetratomic, their molecules containing four atoms each. Chlorine, bromine and iodine are diatomic at temperatures below 1100° F., but above 1100° their molecules are believed (by some authorities) to break up into single atoms, so that at about 2200° F. two-thirds of the little particles present in these substances are free atoms, while the remaining one-third continue to exist as diatomic molecules. Sulphur is hexatomic at 900° F., but its molecules break up somewhat at higher temperatures, and are practically all diatomic above 1500°. According to this view of the case, if H stands for the atom of hydrogen and Cl for the atom of chlorine, what happens when a molecule of one of these gases combines with a molecule of the other is not simply $H + Cl = HCl$, because the molecule of hydrogen must be represented by H_2 and that of chlorine by Cl_2. Hence the process of combination consists of two parts, the first of which is

H_2	+	Cl_2	=	$H + H + Cl + Cl$
Molecule of hydrogen		Molecule of chlorine		Atoms of hydrogen — Atoms of chlorine

The atoms of hydrogen and chlorine, thus set free, then combine to form hydrochloric acid.

It is then written as follows:

$$H + H + Cl + Cl = HCl + HCl;$$

or we may write the whole operation in the following simple manner:

$$H_2 + Cl_2 = 2HCl$$

Dalton, assuming that the formula of ammonia is NH, and knowing by experiment that the weight of the nitrogen present is 4.67 times as great as the weight of the hydrogen, would conclude that the atomic weight of nitrogen is 4.67; but since experiment shows that when ammonia gas is separated into its constituent elements, two volumes of the ammonia yield one volume of nitrogen and three volumes of hydrogen, Avogadro's law requires us to conclude that the true formula for ammonia is NH_3; and hence we must take $3 \times 4.67 = 14$ as the atomic weight of nitrogen. This example will suffice to show how Avogadro's law obliged chemists to modify the atomic weights that would be obtained by the methods known to Dalton. Direct analysis of compounds of an element whose atomic weight is desired will give either that atomic weight itself, or some simple multiple or submultiple of it; but to decide between these several multiples (as for example between 4.67 and 14, in the case cited above), it is necessary to have recourse to Avogadro's law, or to some other equally general principle. Unfortunately Avogadro's law cannot always be applied to the determination of atomic weights, because it frequently happens that no compound of the element under examination can be obtained in the gaseous condition, or that the gaseous compounds that can be obtained are unsatisfactory, for one reason or another, and not adapted to the determination of the particular multiple that should be selected as the atomic weight of the element. In such cases recourse may be had to the law of Dulong and Petit, or to the "periodic law" of Meyer and Mendeléeff. In 1819 two distinguished French physicists, MM. Dulong and Petit, announced that the specific heats of 13 elements upon which they had made careful experiments are inversely proportional to the respective atomic weights of those elements. In other words, that the product of the specific heat and the atomic weight (which product is called the "atomic heat") is the same for all of them. This remarkable generalization did not meet with universal and immediate acceptance, because it failed in numerous cases unless the atomic weights of the corresponding elements were changed somewhat from the values that had been previously assigned to them from purely chemical considerations. Thus in the cases of bismuth, platinum, silver and cobalt, Dulong and Petit substituted multiples or submultiples of the atomic weights then in use; and other changes were also made. Moreover, the law could not possibly be exact, because the specific heats of bodies are not constant, but vary with the temperature, and sometimes to a considerable extent. Subsequent experimenters have paid great attention to Dulong and Petit's law, however, and now that the atomic weights of the more familiar elements have been pretty well determined in one way and another, the law is found to be surprisingly near to the truth, and most of the changes for

which they contended, in connection with previously accepted atomic weights, have since been made. A list of 10 elements whose specific heats have been well determined are presented in the table, to illustrate the degree of accuracy

Element	Atomic weight	Specific heat	Product ("Atomic heat")
Lithium	7.	0.941	6.6
Aluminum	27.	0.214	5.8
Potassium	39.	0.166	6.5
Copper	63.	0.0952	6.0
Silver	107.	0.0570	6.1
Antimony	119.	0.0508	6.1
Tungsten	183.	0.0334	6.1
Gold	196.	0.0324	6.4
Bismuth	207.	0.0308	6.4
Uranium	238.	0.0277	6.6

with which a proposed element may be expected to conform to it. The atomic weights in the table range from 7 to 238, and yet when we multiply each one by the corresponding specific heat, we find that the product (or "atomic heat") remains constant, or nearly so. In some cases (notably for boron, silicon and carbon), a large deviation from the law is observed; but these exceptions cannot be considered in the present place. As an example of the use of Dulong and Petit's law, the case of silver may be cited. Previous to the publication of that law, the atomic weight of silver had been taken at 215. Dulong and Petit pointed out that if this value were retained, the product of the atomic weight and the specific heat greatly exceeded the value 6, to which many of the other elements approximated. They therefore proposed to halve the then accepted atomic weight of this element, and to make (of course) a corresponding change in the formulas of all compounds of silver. Regnault confirmed their experiments, and repeated their demand that the atomic weight be halved. But Berzelius, then the greatest living authority on such matters, refused to consent to the change, on the ground that silver and sodium compounds are isomorphous (see ISOMORPHISM), and that the analogy between the formulas of their corresponding compounds would be destroyed, if the atomic weight of silver were halved, while that of sodium was left unchanged. Regnault then determined the specific heat of metallic sodium, and showed that the atomic weight of that element should also be halved, in order for it to conform to Dulong and Petit's law. Berzelius' objection thus lost its force, and the atomic weights of both silver and sodium were ultimately halved, by universal consent. The "periodic law," already referred to, cannot be adequately treated in this place (see PERIODIC LAW); but it may be said that when the known elements are arranged in the order of their atomic weights, it is found that certain attributes recur in a remarkable "periodic" manner, as we pass from one end of the array to the other. This fact is of great assistance in the determination of atomic weights, because any great error in the assignment of the atomic weight of an element would throw that element among others with which it would have relations entirely out of harmony with analogous relations prevailing in other parts of the array. This "periodic" classification is so powerful and far-reaching that the existence of new and previously unsuspected elements has been predicted by it, and afterward verified (in some cases) by the actual discovery of the elements themselves. The gas "argon" (q.v.) affords an interesting case of the determination of an atomic weight by indirect means. Argon has resisted all attempts to make it combine with other substances, and hence it has been impossible, thus far, to analyze any of its compounds. Its density was found, by direct experiment, to be about 20 times as great as that of hydrogen. Now if, as Avogadro's law states, a cubic inch of argon contains just as many molecules as a cubic inch of hydrogen (under the same conditions of temperature and pressure), then it follows that a molecule of argon weighs 20 times as much as a molecule of hydrogen, or 40 times as much as an *atom* of hydrogen. To find the weight of an atom of argon we therefore merely have to divide 40 by the number of atoms that there are in its molecule. For an explanation of the method by which the number of atoms in the molecule of such a gas is obtained, we must refer to the article GASES, KINETIC THEORY OF; it will suffice, in the present place, to state that it was found that argon is monatomic, its molecule containing but a single atom. Therefore the conclusion was, that the atomic weight of argon is about 40. The "periodic law" was not of any great service in this case, because the properties of the new gas proved to be so unlike those of any previously known substance that its proper place in the general scheme could not be even guessed until its atomic weight had been determined. The subsequent discovery of helium and the other inert gases of the same group showed, however, that the atomic weight already assigned to argon is in reasonably good accordance with the periodic law.

Chemists educated in recent years can hardly conceive the confusion that prevailed 60 years or so ago, while the principles that have been outlined above were struggling for recognition and universal adoption. There was no agreement as to what atomic weights or what formulas should be used. Mendeléeff says: "Some took O = 8 and others O = 16. Water in the first case would be HO and hydrogen peroxide HO_2, and in the second case (as is now generally accepted) water would be H_2O and hydrogen peroxide H_2O_2 or HO. Discussion and confusion were reigning. In 1860 the chemists of the whole world met at Carlsruhe for the purpose of arriving at some agreement on the subject. There was great difference of opinion, and a conditional agreement (or compromise) was proposed and defended with the greatest acumen by the ranks of science. A conditional agreement was not arrived at, and ought not to have been; but instead of it, truth, in the form of the law of Avogadro-Gerhardt, received by means of the congress a wider development, and soon afterward conquered all minds. Then the new so-called Gerhardt atomic weights established themselves, and in the seventies they had already become generally used. As soon as a few of the atomic weights had been determined with some little degree of precision, it became evident that they

came nearer to exact integers than one would naturally expect them to, judging from the theory of probability. As early as 1815, Prout made the assumption (since known as "Prout's Hypothesis") that the true values of these atomic weights are really integral numbers; and he drew the inference that all elements are composed of hydrogen. Thus nitrogen, whose atomic weight is almost exactly 14, he believed to contain 14 times as many atoms to the molecule as hydrogen contains, and he believed the fundamental atom to be the same in each case. There is nothing about this assumption which conflicts with what has been said above about nitrogen being a *diatomic* gas; for all that Avogadro's law positively shows is that when a molecule of that gas divides, it splits into *halves*, and therefore contains an even number of atoms. In the absence of any evidence to the contrary we assume it to be simply diatomic, although we must always remember that future research may require us to admit it to be tetratomic, hexatomic, or even more complex. Prout's hypothesis has provoked a great deal of discussion, and since it was first proposed it has been attacked and defended by many distinguished chemists; and although it is in decided disfavor at present, we can hardly yet say that it has been finally laid to rest. One can scarcely glance at a table of atomic weights (such as that here presented) without noting the tendency shown by these atomic weights to approach integral values. Of course there are numerous conspicuous exceptions — chlorine, for example — but the fact that many of the atomic weights are nearly integral demands some sort of an explanation. What that explanation may ultimately prove to be, we cannot now guess; but it is possible that it will be found in the development of the remarkable "corpuscular hypothesis" of Prof. J. J. Thomson. (See ELECTRON.) The atomic weight of oxygen was long thought to be precisely 16; very careful experiments then indicated that 15.96 is a closer approximation to the real fact; and it has recently been ascertained that 15.88 is a still better approximation. It is a matter of choice what element is taken as having the atomic weight unity, hydrogen having been chosen for this purpose merely because it is the lightest element known. For many purposes it would be convenient if the atomic weight of oxygen were precisely 16; but this value is now known to be incompatible with the assumption that the atomic weight of hydrogen is 1. Chemists have therefore been in the habit, in recent years, of multiplying all the atomic weights, as deduced on the hypothesis that H = 1, by a constant number, so determined as to make the atomic weight of oxygen come precisely 16. It happens that the multiplier required for this purpose is 1.008, which is therefore the atomic weight that must be assigned to hydrogen, if we are to adopt a scale on which the atomic weight of oxygen is to be precisely 16. A majority of the chemists of the world now use this modified scale, on which the atomic weight of hydrogen is taken as 1.008; and the scale so established is known as the "International" scale of atomic weights. The values of the atomic weights on this scale, according to the latest official revision (that of 1917) are given in the accompanying table.

TABLE OF ATOMIC WEIGHTS

Element	Symbol	Atomic weight	Element	Symbol	Atomic weight
Aluminum	Al	27.1	Neodymium	Nd	144.3
Antimony	Sb	120.2	Neon	Ne	20.2
Argon	A	39.88	Nickel	Ni	58.68
Arsenic	As	74.96	Niton (radium emanation)	Nt	222.4
Barium	Ba	137.37	Nitrogen	N	14.01
Bismuth	Bi	208.0	Osmium	Os	190.9
Boron	B	11.0	Oxygen	O	16.00
Bromine	Br	79.92	Palladium	Pd	106.7
Cadmium	Cd	112.40	Phosphorus	P	31.04
Caesium	Cs	132.81	Platinum	Pt	195.2
Calcium	Ca	40.07	Potassium	K	39.10
Carbon	C	12.005	Praseodymium	Pr	140.9
Cerium	Ce	140.25	Radium	Ra	226.0
Chlorine	Cl	35.46	Rhodium	Rh	102.9
Chromium	Cr	52.0	Rubidium	Rb	85.45
Cobalt	Co	58.97	Ruthenium	Ru	101.7
Columbium	Cb	93.1	Samarium	Sa	150.4
Copper	Cu	63.57	Scandium	Sc	44.1
Dysprosium	Dy	162.5	Selenium	Se	79.2
Erbium	Er	167.7	Silicon	Si	28.3
Europium	Eu	152.0	Silver	Ag	107.88
Fluorine	F	19.0	Sodium	Na	23.00
Gadolinium	Gd	157.3	Strontium	Sr	87.63
Gallium	Ga	69.9	Sulphur	S	32.06
Germanium	Ge	72.5	Tantalum	Ta	181.5
Glucinum	Gl	9.1	Tellurium	Te	127.5
Gold	Au	197.2	Terbium	Tb	159.2
Helium	He	4.00	Thallium	Tl	204.0
Holmium	Ho	163.5	Thorium	Th	232.4
Hydrogen	H	1.008	Thulium	Tm	168.5
Indium	In	114.8	Tin	Sn	118.7
Iodine	I	126.92	Titanium	Ti	48.1
Iridium	Ir	193.1	Tungsten	W	184.0
Iron	Fe	55.84	Uranium	U	238.2
Krypton	Kr	82.92	Vanadium	V	51.0
Lanthanum	La	139.0	Xenon	Xe	130.2
Lead	Pb	207.20	Ytterbium (neo ytterbium)	Yb	173.5
Lithium	Li	6.94	Yttrium	Yt	88.7
Lutecium	Lu	175.0	Zinc	Zn	65.37
Magnesium	Mg	24.32	Zirconium	Zr	90.6
Manganese	Mn	54.93			
Mercury	Hg	200.6			
Molybdenum	Mo	96.0			

The many questions that suggest themselves as to the size and physical nature of atoms belong properly to the domain of physics, and are discussed under BROWNIAN MOVEMENT, ELECTRON, and MOLECULAR THEORY. The day will doubtless come when the physicist and the chemist will find some common ground for the discussion of the nature of atoms and molecules; but at present these two sciences deal with such widely different classes of phenomena that no such common ground can be clearly discerned. The atom and the molecule of the physicist appear to be hardly capable of possessing the properties that the chemist demands; but this difficulty may one day be overcome. See CHEMISTRY; ELECTRON; MOLECULAR THEORY; GASES, KINETIC THEORY OF; VALENCY; SPECTROSCOPE; PERIODIC LAW.

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ATOMICITY. See VALENCY.

ATOMIZER. See INTERNAL COMBUSTION ENGINE.

ATONEMENT. The Atonement is the caption under which Christian theology introduces the discussion of the application of the merits of the life and death of Christ to the reconciliation of fallen man to his Creator, as well as of the acceptance thereof by the Divinity. It expresses the crowning effect of the incarnation. It is, in this sense, an attempt at an explanation of the coming of the Redeemer. In a general way it means compensation, res-

toration, expiation, satisfaction, ransom. It is a word made up etymologically of *at* and *one*, and suggests that two who were divided have become one again. It embraces all that the Saviour accomplished to nullify the effects of sin. The atonement is considered to have repaired the consequences of the primal transgression, all the moral consequences, say some, say most of the authorities. As to the physical outcome of the rebellion in Eden, it claims no change save that, through it, man has been enabled to bear patiently and meritoriously all the ills of existence and to wrest from what is evil a good that worketh unto satisfaction. The atonement idea is coexistent with what, in order to avoid conflict with those who think otherwise, may be called Biblical humanity; that is, the race whose chronicle is found in the pages of Scripture. It has no meaning for those who reject the inspiration of Holy Writ or for those whose beliefs are antagonistic to Christianity. With these, if there be any atonement at all, it lies in an evolution, by virtue of which man develops from worse to better and in the "process of the suns" reaches, unaided, to a deliverance and a perfection far surpassing even the dreams of Christianity. The subject is a vast one. It has many and far-reaching ramifications which are constantly in contact with every issue of soteriological study. To confine it within the limits of an encyclopedic article necessarily cramps it and scarcely makes for completeness. All that can be done is to present its general features, the basis on which it rests, and some of the opinions which deserve attention in the different stages of development incidental to its growth. The fact upon which the doctrine reposes is that narrated in Genesis iii, wherein the prevarication of the first couple is said to draw on them and posterity the curse of the Almighty, which He tempers with the promise of a Redeemer to come. This violation of God's command, while it rendered Adam and Eve criminal and placed them under a ban, was at the same time an insult outraging, as much as anything finite could, the infinite perfections. Thus a condition was brought about which consigned man to punishment and left an affront against the Creator to be, in some way or other, atoned for. In this plight the whole race was involved and became ostracized from God. All humanity was confronted by a God whose infinite justice called for an indemnity of some kind as a reparation for the indignity offered to His perfections, by a penal sentence to be endured, by the loss of innocence, by the unbridling of concupiscence and by a slavery which reduced it to the thrall of the prince of the powers of darkness. Immediately is perceived the gaping breach which the atonement had to bridge over. Could the restoration be achieved by man himself and alone, or by entire humanity? The general answer is a negative. It is clear from the attitude into which man was forced by his sin what the questions are which in this discussion call for a reply. The views entertained by theologians are not marked by very harmonious notes. There is a very great discrepancy of opinion. Like other doctrines, that of the atonement did not come into existence full grown. It was not formulated in the beginning. Hints of its nature are found in the New Testament. By Christians up to the time of the Reformation it was received from individual teachers, by whom, as by the laity, it was instinctively grasped, though scarcely expressed, and thus in many forms traversed the duration of nearly 15 centuries. Whenever, during all that period, it was treated by the fathers and doctors and other writers, there was unanimity on this one point: that the atonement was effected by the incarnate Son of God and that the satisfaction was complete and answered all the exactions of a just Deity, while it simply deluged man with a sea of spiritual blessings. Their contention, summed up, was that it was in the absolute power of God to pardon man without any atonement, without sending His Christ. In His wisdom, however, consulting not only the great wrong perpetrated against Him, but the welfare of His creatures, He decreed the incarnation of His divine Son, the second person of the Blessed Trinity. That Son incarnated was both God and man, possessing two natures in one person. This person was divine. As all acts are attributable to the personality of the individual, it followed that the acts of the God-man were divine, and so, whether proceeding from the human nature or not, they were infinite in value. It was necessary for an atonement act to have infinity, because sin, though committed by a finite agent, was in a measure infinite, since its malice was directed toward a being infinite in nature. Theologians made the distinction that sin was finite subjectively, but objectively infinite. The divinity of the person made the atonement secure on the side of the Father. Man was doubly privileged. The Redemption of Christ obtained for him, through grace which had its efficacy in the blood of the Saviour, the remission of sin, and strengthened him against his own weakness, his own passion and the wiles of the enemy from whose thraldom he had been rescued. In a word, the insult to the Father was wiped out; man was restored to the old friendship, was endowed with the means of justification and sanctification and his feet put on a path to the vision of God, in the enjoyment of which sin becomes an impossibility and happiness is supreme. With very few exceptions this, more or less completely, was the form the atonement took in the thoughts of the large majority of teachers of the Church for a decade and half of centuries. They labored to hold up the dignity and liberality of the atonement. The Atoner was Christ, and He atoned through His sacrifice on the cross in a manner ample beyond all human reckoning. But the atonement was not a thing of Christianity only; its effects reached back to the whole past of man, for the Lamb who atoned was "slain from the foundation of the world." They argued that the redemption was universal as to time and place and for all the generations of man. All the peoples before Christ came within its pale. No man, however incult, fell outside of the plan of redemption. Everyone everywhere could find its blessings within his reach. It wrought from alpha to omega on the race. Not the chosen people only, but the Gentiles as well participated in its benefits. It was taught in the period under reflexion that just as soon as the Redeemer was foretold to Adam and Eve the atonement began to energize in some inexplicable manner, but always with a view

to the merits of Christ, who was to come in the fullness of time and pay the ransom. The concession of the Creator in granting a Redeemer who was to make plenary atonement for every man until the passing away of the race was, before the incarnation, a promissory note—if it may be allowed to use the term — a promissory note of salvation accepted and honored by the Maker, who knew that at the appointed time a priceless amount would be stored up for its redemption. The atonement idea, that is, the necessity of making amends to a Ruler whose mandates had been and were being violated, prevailed everywhere in the ancient world and was not confined to the descendants of Abraham. Sacrifices, propitiatory and expiatory, so common among the ancient idolators, are evidence sufficient. Among them was an uppermost thought that reconciliation with God or with the gods could not be brought about by individual efforts alone. The sacrifices of Israel emphasize the essence of all atonement. A victim was always called for. Something outside of the transgressor had to be offered to effect the lifting of the ban. That blood offerings, or others, were ineffective, save indirectly and by a mysterious connection with the oblation of Christ, is admitted throughout the extent of ante-Reform tradition. In the Jewish mind the concept of sacrifice in a multitude of cases connoted effusion of blood. The Hebrews were instructed that transgressions placed on the back of the victim died with the victim. This only in a measure, for it does not appear that they professed that after the death of the victim the guilt of the sacrificers was canceled without any further act or cooperation on their part. Repentance was necessary and each had to do his utmost to share by individual action in the redeeming work of the sacrificial object. The vexed subject of imputation (q.v.) recurs frequently but cannot be touched here. The religion of the Jews was distinguished by the number and variety of its sacrifices. But atonement was ever before their eyes. Yom hakkippurim, or Day of Atonement, is another proof. It was a penitential occasion. Its austerity was rigorous. From the evening of the 9th to the evening of the 10th of the seventh month no bodily labor could be done, no food taken under penalty of death. All the ritual was carried out by the high priest, who offered sacrifices for the sins of himself, of the priesthood and of the people. For the typical meaning of these ceremonies see Heb. viii-x, and for a description of the solemnity cf. Lev. xvi. These types ceased with the advent of Christ. Mention has already been made of the gradual development of the doctrine of atonement. From the death of the Saviour it was admitted that "Jesus died, the just for the unjust, to redeem mankind from the bondage of corruption and to restore the broken connection between heaven and earth." Different ways of looking at this fundamental axiom of Christianity in general have suggested various explanations. The conditions of the dispute led to many questions which relate to the incarnation. The one thing the teaching Church held to was that Christ as man is the first and supreme mediator between God and man (1 Tim. ii, 5). Because as man He was a created being He is below God, but is above all creatures by reason of the plenitude of His grace and glory. As man he offered to God a satisfaction so singularly adequate that by it was destroyed "the handwriting of the decree" so adverse to us, and by it also man was endowed with all that is requisite to be in friendly association with God, by grace in the present and by glory in the future. Others, ministerially or otherwise, may co-operate in uniting God and man, but Christ is the chief and first and literally the only mediator (Billot).

The doctrine of the incarnation in its entirety illumines this subject, but of it and of other cognate subjects, such as justification and original sin, notice cannot be taken here. The atonement, as such, has not been treated specifically by early writers, and it would be difficult to put one's finger on any dogmatic decree in which it is definitely formulated. Just as from definitions here and there spread over the volume of authoritative teaching the nature of the atonement is elicited, so from the utterances of ecclesiastical writers one is able to reach a conclusion in harmony with the affirmation of tradition. The view still claiming attention bases itself on Scripture. Texts therefrom are not necessary for the present writing; they embrace the prophetic language of the Old and the literal language of the New Testament. The Apostolic Fathers, from Clement to Polycarp, are satisfied with stating the fundamental idea that "Christ died for us" and for our sakes. Irenæus and Origen insist that a price had to be paid to Satan because Satan had gained a rightful mastery over and ownership of men, for which the only equivalent was the blood of Jesus. This view was never universal, but now and again it is brought forward, even up to the time of Peter Lombard. The Fathers and writers from Origen to Anselm wrote more systematically on nearly every topic, but were unanimous in maintaining that the death of Christ was the sacrifice unique and par excellence and amply satisfactory. Some do, others do not, endeavor to explain whether and why this sacrifice was imperative. This is true of the Church East and West, Greek and Latin. Two ideas are prominent: the infinite value of the human acts of Christ, and the need of grace for human weakness. More stress is placed on the incarnation than on its concomitant effecting of the atonement. "The work of mediation was summed up but not exhausted in the dying. He was a priest and a sacrifice from the beginning, and is and always will be. The imitability of Christ's career was not confined to the death on the cross, but as well to the whole existence" (Newman).

Ocasionally a peculiar view would startle the world, but without changing the generally accepted opinion. Anselm (1033) in his 'Cur Deus homo' vigorously opposes the view of Origen and others concerning the so-called bargain by which the Almighty, through Christ, purchased back the souls of men from the grasp of Satan. Then came the age of the Schoolmen. It has been the custom to look upon these men as triflers and hair splitters, but what Huxley says of Saint Thomas is, with modification, applicable to many of these very imperfectly known and much abused investigators: "His marvelous grasp and subtlety of intellect seem to me to be almost without a parallel" (Science and Morals). They all united

in declaring that Christ by His sacrifice was the Atoner. They differ in their explanation of some points connected with the incarnation which are irrelevant here. They are broad and moderate in their views. Christ not only freed us from sin, says Aquinas, but won for us grace and glory, and it was fitting that by death He should overcome the power of death, but His death need not have been a violent one. Over the question whether the incarnation was an absolute necessity or only something congruous, they run through every note of the gamut of argument. Duns Scotus is one of the principal figures in the discussion. Among other views he maintains that a mere man conceived without sin, or a good angel, could have made satisfaction for the entire race had it pleased God to accept it. Express treatises on the atonement cannot be found. It is always treated as an adjunct of the incarnation. There have been many pious and devotional essays on this topic. Since the days of the scholastics all Catholic analysis of the atonement can be traced back to them or to the Fathers and doctors. The Reform opens with the 15th century of modern times, and those leaders only who have left an indelible impress upon their followers will receive attention. Arians, and those who reject the divinity of Christ directly or by implication, fall outside this inquiry.

An insistent tenet of the Reformers is, that Christ reconciled God to us, whereas the Tridentine Council teaches that He reconciled us to God. The Divinity by the very force of the divine perfections, Catholics hold, remained in itself unchanged. The fall affected man, that is, man by his transgression placed himself voluntarily under the ban of infinite justice and willingly subjected himself to all the consequences of his disobedience. Man alone changed. God's attitude was always the same. In one of his bulls Leo X (1520) condemned 41 propositions of Luther, some of which in one way or another refer to the doctrine of the atonement. In the sixth session of the Council of Trent the decrees on justification, on the advent of Christ, etc., (Dec. Concil. Trid.) set forth a basis for views on the Atonement which are in opposition to those of Luther and others. Luther denies the supernatural character of man's original sanctity. God, according to Luther, planted in the very essence of human nature the capabilities and the acts of virtue. Hence no freedom of will. Sin is of the essence of man. Man is wholly evil. Calvin asserts that everything coming from man's corrupt nature is damnable and so can in no way co-operate in the atonement. It must all occur outside of himself. He contributes nothing. He is justified; he is reconciled to God, or God is reconciled to him through faith in the merits of Christ, whose obedience becomes man's obedience and whose righteousness becomes man's justification. In this way the Creator remits sin, reputes man just and rewards him with eternal life. Christ made satisfaction for sinners in two ways: by fulfilling the law in their place and by enduring the curse and penalty of the law. Everything in the atonement becomes vicarious. Another person is substituted for the debtor and the criminal. These doctrines are gathered from the Epistles of Saint Paul. Only the bare statement has been here presented of the doctrine of the Reformers. A review of the reasons advanced to sustain this teaching would repay the student. Those who came after Luther and Calvin and Melancthon modified in a lesser or greater degree this teaching and modified the idea of transference as atonement and demanded at least some co-operation, on the part of the sinner. Imputation soon became the great battleground of controversy. Investigation will reveal that in the Protestant churches there has been a recoil from the positive utterances of the Reformers. The disparity existing between the above and what can be gleaned from the early and modern history of the Catholic Church is undoubtedly marked. So much so that Pusey in his introductory essay to 'Essays on the Reunion of Christendom' observes: "The Lutheran and the Catholic belief are as like two different religions as any can be, wherein the belief as to the adorable Trinity and the incarnation is the same. The *whole* doctrine of the application of the merits of Christ to fallen man and the condition of man in consequence of the fall is radically different." In fact, the difference is so radical that there is no possibility of confounding one with the other. All Protestant theology from the rise of that religion is a literature which is within the reach of any one to consult, and further quotations or references are unnecessary. "Just as the justice of man binds the judge to punish the criminal, so is some penalty exacted from man by virtue of the same attribute, which, of course, is more perfect in the divinity. It is not the spirit of vengeance which animates God. In spite of the transgression God's love remains as it was in the beginning, without diminution or alteration of any kind. The Son of man died for all men sufficiently, for the elect efficiently. Satisfaction is required of man. But that satisfaction is amply made by man by believing, who thus becomes one with the Redeemer and shares with Him in the redemption He wrought as the Head of the Redeemed. This is enough to excite love and repentance and the striving after holiness."

Everything quoted above, though taken from different writers, expresses the view of the Atonement as held by Protestant expounders.

In later years, both in Germany and elsewhere, the theology outside of the Catholic Church, while apparently concordant with the opinion of the necessity of man's co-operation, harks back, consciously or unconsciously, to the belief of Luther and his immediate disciples that Christ atoned fully, and so fully that the sinner need only by some interior act appropriate to himself the work already done by the Saviour. Where there is any insistence that man must of himself do something positive, in so much is that insistence at variance with the thought that in the beginning of the Reformation was spread broadcast among the adherents of the New Religion. Might there not be drawn a distinction between atonement and salvation? The atonement would mean that Christ had done all that was necessary to reconcile man with God, but there could be no salvation unless man turned to God through the path of the atonement and by individual repentance and satisfaction so comported himself as to bring by voluntary acts his life into entire harmony

with the will of his Creator. No solution of the evidently complicated nature of the atonement will compel conviction which does not answer adequately the following questions: What is the relation of the atonement to an offended God? What was His acceptance of the sacrifice? How far did that sacrifice in itself go toward bringing God and man together? Was it alone enough to liberate man so absolutely that after the death of the victim no more was expected on his part? How were the outraged excellences of the Godhead — His justice, His mercy, His love — compensated for the injury done them by sin? Did that injury really affect the divine nature? It may be advanced here that in every theory which possesses any serious claim to assent the Supreme Being remained unimpaired in the beauty of His perfection, and it was due to the infinite justice of God to demand a congruous if not a condign reparation. What part does Satan play in the plan of redemption? Has a solution been presented? Is it and will it always be an impenetrable mystery? It is a matter so significant for Christians that they have the right to expect from some form of Christianity a clear exposition based on Scripture and authoritative teaching. For Christians it means salvation, regarding which certainty is security and doubt a calamity.

Thus much for Christianity, which emphasizes the necessity of an atonement. All Christians admit Christ as the fountain head of all reconciliation of man with God. But the world is far from being entirely or even largely Christian. In the world to-day there are about 1,500,000,000 human souls, of which number only a little over 400,000,000 have received the religion of Christ. Half of these, it is computed, are Catholics, the remainder are Protestants or Catholics of some kind or other, but divided from the See of Rome. The rest of the race is either Jewish or Mohammedan or belongs to some Oriental form of worship or is out and out heathen. Will Christianity assume the responsibility of stating that beyond its pale the atonement does not reach and that therefore for the pagan there is hope neither here nor hereafter? Some mention has already been made of the Jews and their manner of atonement. Their views have crystallized into the shape which their orthodox members adopt to-day and which they base upon certain books of the Old Testament, upon their Talmud and their Targum. It differs in no way materially from the teachings of Moses and the Law and the Prophets. They lived in the past as they are living now in the hope of a great Deliverer to whom every act of worship bore and bears reference. In some way or other these typical ceremonies, it is said, influenced Jehovah to make them the promise: «I will be merciful to their iniquities, and their sins I will remember no more» (Hebrews viii, 12). The space of this article is inadequate to include even the most summary account of the atonement idea as it was understood by the nations outside of the chosen people. Research has made it admissible that everywhere there have been religious beliefs, opinions and practices pointing to the acknowledgment of a Supreme Being and judgment to come and a reward or punishment in a life beyond this. With this are apparently connected sacrifices which no matter how accompanied by fanaticism and superstition are an attestation of a homage paid to a deity, a homage of praise, or petition, or thanksgiving or of supplication for pardon — a homage which was inspired by an underlying sentiment of the need of appeasing some offended divinity. Yet it is not easy to trace this need in those religions which are so widespread in the Levant and farthest East and proclaim as fundamental Fatalism, Metempsychosis and Pantheism. The investigation of the subject of atonement as advanced by the followers of Christ, by those followers who profess that Jesus was the Son of God, that is, was Divine, among other questions inevitably suggests the question of the possibility of salvation for all individuals of the race whose creed negatives Christianity altogether. Some reply, adequate or otherwise, may be found in the dogma that «Christ died for *all* men,» whence the inference is deducible that even those who never heard of the Redeemer, or the atonement, cannot but be affected by that death. How? is a large thesis. That the problem has been approached by honest and able thinkers is plain to the readers of history. In the Christian world there is no small number who deny the primal fall and hence see nothing urgent in the discussion of the atonement. The Messiah has not yet reached this earth say the Jews, Christ was not God, say the Arians, there is no God, say the Atheists, if there be He is unknowable, say the Agnostics. For all these the atonement has very slight, if any, significance. Teachers of note advance the theory, basing it on Scripture, that the first tradition of a redeemer to come and who was to atone was carried by the earlier peoples as they grew and scattered and populated the earth. The Jewish idea brought by the Israelites in their wanderings and captivities, and assimilated by the tribes and nations among whom they dwelt, was in the lapse of time weakened or metamorphosed, or adapted to pagan beliefs and so corrupted. «The only theory which accounts for all these facts,» says Rawlinson, «is that of a primeval revelation variously corrupted through the manifold and multiform deterioration of human nature, in different races and places.»

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ATOSSA, the daughter of Cyrus, 530 B.C. She was successively married to Cambyses, Smerdis, one of the Magi, and Darius, son of Hydaspes, the last of whom she incited to invade Greece. It is given in one account that she was killed by her son, Xerxes. The word served as a poetical name given by Pope, in his 'Moral Essays,' to Sarah, Duchess of Marlborough.

ATRATO, ą-trä'tō, river of Colombia, of note, because it has repeatedly been made to bear a part in schemes for a ship-canal across the Isthmus of Panama. Rising on the western Cordillera at an altitude of 10,560 feet above sea-level, it runs 305 miles northwest through low, swampy country and falls by several mouths, interrupted by bars, into the Gulf of Darien. It is navigable by steamers for fully 250 miles, being 750 to 1,000 feet wide, and 8 to 70 feet deep. A route, surveyed by the United States government in 1871, proposed to connect the Atrato and the San Juan, flowing into the Pacific, by a canal 48 miles long. At the Paris International Congress (1879), that route was, with various others, discussed and rejected in favor of De Lesseps' line from Limon to Panama. Gold-dust is found in and about the Atrato.

ATRAULI, town of India, in the northwest provinces. It is clean, well built and has a good trade.

ATREBATES, ą-trĕb'ą-tēz, or ăt're-bā'tēz, the ancient inhabitants of that part of Gallia Belgica afterward called *Artois.* A colony of them settled in Britain, in a part of Berkshire and Wiltshire.

ATREK, ą-trĕk', river of Asia, forming the boundary between Persia and the Russian Transcaspian territory, and flowing into the Caspian. It takes its rise in the northeastern part of the country, in the neighborhood of Kuh Rizeh Mountain, which attains an elevation of 9,700 feet. The general course of the stream is westward. Its length is over 300 miles.

ATREUS, ā'troos, in Greek legend, the son of Pelops and Hippodamia. He and his brother, Thyestes, murdered their half-brother, Chrysippus, from jealousy of the affection entertained for him by their father. Thereupon they fled to Eurystheus, with whose daughter, Aërope, Atreus united himself, and after the death of his father-in-law became King of Mycenæ. Thyestes had two sons by the wife of his brother, and was banished by Atreus. Thirsting for revenge, Thyestes conveyed away secretly a son of his brother, and instigated him to murder his own father. This design was discovered, and the youth, whom Atreus thought to be the son of his brother, was put to death. Too late did the unhappy father perceive his mistake. A horrible revenge was necessary to give him consolation. He pretended to be reconciled to Thyestes, and invited him with his two sons to a feast, and after he had caused the latter to be secretly slain he placed a dish made of their flesh before Thyestes. When the father had finished eating Atreus brought the bones of his sons and showed him the dreadful revenge which he had taken. Atreus (or his son Pleisthenes) was the father of Agamemnon and Menelaus, who are hence called the Atridæ, Atridēs (the singular) being often distinctively applied to Agamemnon.

ATREUS, Treasury of, a subterranean building at Mycenæ, so styled by Pausanias and frequently referred to as "the tomb of Agamemnon." It is a vaulted tomb resembling a bee-hive in construction, its arch being composed of projecting horizontal courses of stone narrowing as the top is approached. It contains a circular chamber 50 feet wide with a smaller square one adjoining.

ATRI, ä'trę, Italy, the ancient *Adria;* a town of the province of Teramo, 14 miles southeast of the city of Teramo, on the Brindisi Railroad. There are some ruins of ancient walls and buildings. The cathedral is interesting for its frescoes, and a 15th-century painting of the Madonna worshipping the child. It manufactures silk, soap and licorice. Pop. 14,043.

ATRIPLEX, a genas of herbs or shrubs of the family *Chenopodiaceæ,* consisting of about 250 species, widely distributed in temperate and tropical regions, usually along sea-coasts or in alkaline soil. Not less than 100 species occur in the United States, chiefly in the western part, where some of them, especially the shrubby species (generally known as salt-bush, shad-scale, or incorrectly as sage-brush), are often very abundant, forming the most conspicuous feature of the vegetation. They are important as being valuable for forage for stock, particularly sheep. Attempts have been made to grow some of the species, especially Australian ones, for forage in the southwestern United States, but without much success. *A. hortensis,* orach, is sometimes cultivated for its leaves which are used like spinach.

ATRIUM, the entrance hall and most important apartment in ancient Roman houses. It was usually ornamented with statues and various family relics, and in the roof there was an opening called the *compluvium,* toward which the roof sloped so as to throw the rain-water into a cistern in the floor known as the *impluvium.* In this room the nuptial couch was placed, and here the matron with the women of the household sat and spun. It was also used as a reception room for visitors and clients. As the Roman home became more sumptuous several small rooms were added around the atrium. Its form also changed. First came the atrium testudinatum with solid roof, followed by the Tuscan type which long remained popular. Its roof sloped inward as stated above. Later columns were added to support the roof and in the Augustan period a real colonnade was added. During the empire the atria were profusely decorated with frescoes and sculptures. Several well-preserved types are to be seen at Pompeii. In mediæval times, till the 12th century, the name was given to a covered court, somewhat on the model of the ancient atrium, constructed in front of the principal doors of an edifice. Later the cloister at the side of the church, for the use of the monks, took the place of the atrium.

ATROPA, a genus of plants of the natural order *Solanaceæ.* Its best known species is probably *A. belladonna.* See BELLADONNA.

ATROPATENTE, Persia, a province of the ancient kingdom of Armenia, of which it formed a part from 149 B.C. to 428 A.D. It is

now a province of Persia, known as Azerbaijan, or Adarbaijan, the principal city being Tabriz. The name was derived from one of the governors of Alexander the Great, who governed the district in 328 B.C. The second largest city in the province, Urumiah, on the shores of a lake of the same name, figured largely in ancient history.

ATROPHY, a term denoting a diminution in the size of the organs, or tissues that make up the body. It is part of the physiological process in its simpler forms, as many parts of the body atrophy and become of secondary service in adult life; the thymus gland and umbilical vessels being examples. It may also be a symptom of disease, particularly in affections of the nervous system in which the trophic fibres of an organ are involved. It may also indicate a perverted state of nutrition. See NUTRITION.

ATROPINE, a crystalline alkaloid obtained from the deadly nightshade. Its chemical formula is $C_{17}H_{23}NO_3$. The plant contains the alkaloid hyoscyamine, which, by the addition of potash to the juice, is converted into atropine. The atropine is extracted by shaking the alkaline liquid with chloroform. The layer of chloroform is evaporated, leaving a residue which is extracted by means of dilute sulphuric acid and precipitating with potassium carbonate. The alkaloid is recrystallized from alcohol. Atropine itself is insoluble in water, but its sulphate is readily soluble. It is extremely poisonous. Large doses cause delirium, convulsions, and finally stupor and death. It is employed for several purposes in medicine, to relieve pain or spasm, and to arrest excessive sweats. The physiological action of atropine is chiefly exerted on the nervous system. It is a strong stimulant, particularly of the motor and respiratory centres, and paralyzes the end filaments of many nerves, particularly those that supply the secretory glands, the involuntary muscles and the heart. Its chief poisonous symptoms are, in the stage of excitement, dryness of the mouth and pharynx, with anæsthesia, a hot dry skin, dilatation of the pupil with blurred vision, due to paralysis, extreme restlessness, due to the motor excitation, a noisy, busy and incoherent brain action, perhaps a delirium, quickened pulse, quickened respiration. This stage may pass into one of depression in which the patient becomes comatose, the pulse and respiration become slowed and death results from asphyxia. Treatment of the poisoning should include prompt washing of the stomach, emetics being of no service because of the anæsthesia, artificial respiration, infusions of hot coffee, and general supportive measures. See BELLADONNA; SOLANACEÆ.

ATROPOS, ăt'rō-pŏs, the eldest of the Fates, who cuts the thread of human life with her shears. In art she is often represented with a cutting instrument, a sundial or a pair of scales.

ATSUTA, ȧt-soo'tȧ, Japan, a town in the southern part of Honishu, practically a suburb of Nagoya, with which it is connected by rail. It contains a number of Shintoese temples, in one of which the sword forming part of the Japanese imperial regalia, is kept. Pop. 24,491.

ATTACHÉ, ȧ'tȧ'shā', a military, naval or subordinate member of the diplomatic service attached to an embassy or legation. Modern usage in effect restricts the term to subordinate officers of an embassy or legation. Military and naval attachés are officers of those services accompanying their country's minister, detailed especially to observe movements of interest to the military or naval administration of their own country.

ATTACHMENT, in law, a taking of a person, goods or estate by virtue of a writ or precept. It is distinguished from an *arrest* by proceeding out of a higher court by precept or writ, whereas the latter proceeds out of an inferior court by precept only. An arrest lies only against the body of a person, whereas an attachment lies often against the goods only, and sometimes against the body and goods. It differs from a *distress* in that an attachment does not extend to lands, while a distress cannot touch the body. In the United States attachment may be defined as the taking into the custody of the law the person or property of one already before the court, or whom it is sought to bring before the court; also a writ for this purpose. To some extent it is of the nature of a criminal process. In some States a plaintiff can at the beginning of an action to recover money attach the property of the defendant as a security for the payment of the judgment expected to be recovered; and in case of recovery the property is applied in satisfaction of the judgment. But the more usual rule is that there can be no seizure of property, except in specified cases, till the rights of the parties have been settled by judgment of the court. The exceptions are chiefly in cases where the defendant is a non-resident or a fraudulent debtor, or is attempting to conceal or remove his property. In some States, attachments are distinguished as foreign and domestic — the former issued against a non-resident having property within the jurisdiction of the State, the latter against a resident in the State; jurisdiction over the person or property being necessary for an attachment. An attachment issued under a State law not adopted by Congress, or by a rule of court, cannot be sustained in a United States court. Consult Drake, 'Treatise on the Law of Suits by Attachment in the United States' (Boston 1891). Consult also works referred to under EXECUTION.

ATTACK, a term denoting the opening act of hostility by a force seeking to dislodge an enemy from its position. It is considered more advantageous to offer than to await attack, even in a defensive war. The historic forms of attack are: (1) The parallel; (2) The form in which both the wings attack and the centre is kept back; (3) The form in which the centre is pushed forward and the wings kept back; (4) The famous oblique mode, dating at least from Epaminondas, and employed by Frederick the Great, where one wing advances to engage, while the other is kept back, and occupies the attention of the enemy by pretending an attack. Napoleon preferred to mass heavy columns against an enemy's centre. The forms of attack have changed with the weapons used. In the days of the pike, heavy masses were the rule, but the use of the musket led to an extended battle

front to give effect to the fire. The advent of magazine rifles, machine and rapid-fire guns, breech-loading field and horse artillery guns, smokeless powder, etc., has reduced the methods of attack to a practical science. See TACTICS.

ATTAINDER, the legal consequence of a sentence of death or outlawry pronounced against a person for treason or felony, the person being said to be attainted. It resulted in forfeiture of estate and "corruption of blood," rendering the party incapable of inheriting property or transmitting it to heirs; but these results now no longer follow. Formerly persons were often subjected to attainder by a special bill or act passed in Parliament. In the United States, the Federal Constitution declares that "No bill of attainder shall be passed, and no attainder of treason, in consequence of a judicial sentence, shall work corruption of blood or forfeiture except during the life of the person attainted." Similar provisions have been inserted in the Constitutions of several States, while in others all forfeitures of property have been abolished. Consult Blackstone, 'Commentaries'; and Stephen, 'New Commentaries on the Laws of England' (London 1903).

ATTAINT, a writ at common law against a jury for a false verdict. It was a proceeding of the nature of an appeal from a judgment entered upon the verdict of a jury. When such a writ was issued a special jury of 24 persons was summoned to pass upon the verdict of the first jury. It was abolished in England in 1825 except as to jurors guilty of embracery. See ATTAINDER.

ATTALEA, a genus of about 20 species of mostly tall, smooth-stemmed tropical American palms with large pinnate leaves sometimes used for thatch, mats, hats, etc., and with nut fruits enclosed in a fibrous husk. *A. funifera,* the piassaba palm of the coast provinces of southern Brazil, yields a cordage of great strength and durability in sea water. Its fruits (coquilla nuts) are as large as ostrich eggs and are used like vegetable ivory (see VEGETABLE IVORY). The piassaba palm of northern Brazil is a different species. It furnishes a fibre which is exported. *A. excelsa* and *A. speciosa* furnish nuts which are burned in rubber-making to dry and color the rubber obtained from *Siphonia elastica. A. compta,* the pindóva or indājá palm, a handsome species with a wide-spreading crown, yields edible fruits as large as goose eggs. *A. cohune,* indigenous to Honduras, supplies a fruit from which the oil is extracted for soap-making at home and abroad. Several species are cultivated in greenhouses, but are generally considered too slow of growth from seed to be satisfactory.

ATTALIA, the ancient name of the modern Adali, a city on the south coast of Asia Minor, above the head of the Gulf of Adalia. Attalus II of Pergamum founded it in the 2d century B.C. During the height of Roman colonial expansion it was an important seaport, being on the main highway between the northwestern provinces of Asia Minor and the south coast. Reference is made to it in the Bible; it was from this port that Paul sailed to Antioch in Syria after his first missionary journey (Acts xiv, 25).

ATTALUS, the uncle of Cleopatra, wife of Philip II of Macedon. He served as general in Philip's armies. He opposed Alexander after Philip's death and was put to death by order of the former.

ATTALUS, the names of three kings of ancient Pergamus, 241–133 B.C., the last of whom bequeathed his kingdom to the Romans. All were munificent patrons of art and literature.

ATTALUS, Flavius Priscus, prefect of Rome under Honorius and Emperor of the East for one year, 409–10. He was proclaimed by Alaric and his Goths who set up Attalus at Ravenna. The latter ordered Honorius to leave the throne, retire and cut off his feet. Alaric soon failed to support Attalus and he was deposed. He was again put forward as Emperor by Ataulphus in 414, but was taken prisoner by Honorius. Honorius cut off his thumb and forefinger and banished him to the island of Lipari.

ATTÂR, ät-tär', **Ferid Eddin,** celebrated Persian poet: b. near Nishapur 1119; d. about 1229 (?). The son of a spicer, he followed his father's trade (whence his surname of Attâr), but afterward became a dervish and one of the greatest mystics of Persia. He is said to have been killed by a Mongol soldier during the invasion by Jenghiz Khan. Of his extant political works the most famous are 'The Book of Council,' a series of didactic poems on ethics; 'The Parliament of Birds' (1184–87). His principal work in prose is 'Biographies of the Saints.'

ATTAR, or OTTO, OF ROSES, a perfume extracted from rose petals. It is a volatile oil, of soft consistency, nearly colorless, and deposits a crystallizable substance partially soluble in alcohol. The best article is prepared at Ghazipoor in Hindustan; but is apt to be much adulterated with sandalwood and other oils. The whole country, for many miles around Ghazipoor, is a garden of roses, and in the spring of the year presents a most beautiful picture of red and green. The roses are used both for rose water and the oil of roses. The latter is obtained from the rose water by setting it out during the night in large open vessels, and early in the morning skimming off the essential oil, which floats at the top. The rose water after the removal of the oil is not so highly valued as before. Attar is also imported from Bulgaria, Persia, Syria and Turkey. In these countries the attar is obtained by distilling the rose petals with about twice their weight of water, the distillate being then exposed in open vessels to the cool night air and skimmed off with a feather in the morning. By weight, one part oil is obtained from 3,000 parts of rose petals. About 20,000 acres are devoted to rose culture in Bulgaria, the annual harvest yielding about 45,000,000 pounds of roses or 8,000,000,000 roses. A one-acre garden under favorable conditions produces 2,000 to 2,500 pounds of roses, from which 10 to 15 ounces of attar of roses may be distilled. Generally 180 to 200 pounds of roses will produce 1 ounce of attar, there being about 200 roses to the pound. The average price, prior to the war, was $12 per ounce. Attar of roses is commonly adulterated with spermaceti and a volatile oil, which appears to be derived from one or more species of *Andropogon,* and which

is called oil of ginger-grass, or oil of geranium. Pure attar of rose, carefully distilled, is at first colorless, but speedily becomes yellowish. It congeals below 80°; melts at 84°. At 57°, 1,000 alcohol dissolve 7½ oil, and at 72°, 33 oil. Specific gravity 872. Formula, $C_{20}H_{20}O_2$. Many attempts have been made to discover some chemical reaction which would reveal the falsification of attar with geranium oil, but hitherto mostly in vain. It is much used for manufacturing hair oil, lavender water and other perfumes. Solid oil of roses (rose camphor, stearoptene of oil of roses) has no odor, is insoluble in alcohol, but soluble in ether. Carbon and hydrogen are its constituents. The liquid oil of roses (rhodineal, eleoptene of oil of roses) is very fragrant and is composed of carbon, hydrogen and oxygen. See PERFUMERY.

ATTAVANTE, ät'tȧ-vän'tȧ, **Marco,** an Italian painter: b. Florence 1452; d. about 1508 or later. He was especially famous for his illuminations, in which class of art he is considered to have been the best of his period. He was also a miniaturist of the highest rank. Among his patrons were most of the great nobles and potentates of the time, including Matthias Corvinus, King of Hungary, the Medici, the Duke Federigo di Urbino and the Dom of Florence. Much of his work, especially his illuminations, is still preserved in the collections of Europe, the best of which is in the manuscripts of Marcianus Capella (Marcus collection in Venice), in a Bible in the Vatican Library and in a Bible of seven volumes in the Belem Monastery in Portugal. Consult article "Attavante" in Bradley's 'Dictionary of Miniaturists' (London 1887) and Meyer and Thiemes, 'Allegemeines Lexicon der bildenen Künstler' (Vol. II, Leipzig 1908).

ATTEMPT, in criminal law an endeavor to accomplish a crime carried beyond mere preparation, but falling short of the execution of the ultimate design in any part of it. 5 Cush. Mass. 367. To constitute an attempt, there must be an intent to commit some act which would be indictable, if done, either from its own character or that of its natural and probable consequences. In some States an attempt to commit a crime is defined by statute. The statute in New York is substantially similar to that of other States. The Penal Code of New York, § 34, provides that "An act, done with intent to commit a crime, and tending but failing to effect its commission, is an attempt to commit that crime." See CRIMINAL LAW, and consult works there referred to.

ATTENTION, a familiar mental state, variously defined as "The act of holding a presentation before the mind" (Baldwin); "Conation in so far as it finds satisfaction in the fuller presentation of its object, without actual change in the object" (Stout); "A purposeful volition, suffused with peculiar feelings of effort or strain and accompanied by a changed condition of the field of discriminative consciousness, as respects intensity, content and clearness" (Ladd). Titchener emphasizes the part played in attention by the clearness of the presented object. This clearness is dependent on the duration, intensity, extension, quality, temporal relations, movement, novelty and familiarity of the stimulus, on the accommodation of the organs of sense for its reception, and in certain cases on the sudden removal of a stimulus to which we have grown accustomed. Titchener interprets clearness as an independent attribute of sensation. While it is universally recognized that attention admits of degrees, and that at the same time as we focus our attention on certain things other things are in what may be termed our peripheral consciousness, there is a considerable amount of diversity of opinion as to the precise nature of the relation between the centre of consciousness and its periphery. For a detailed discussion of the laws of attention, consult Titchener, 'Lectures on the Elementary Psychology of Feeling and Attention' (New York 1908). See CONSCIOUSNESS.

ATTERBOM, ät'tėr-bōm, **Peter Daniel Amadeus,** Swedish poet: b. Asbo, East Gothland, 19 Jan. 1790; d. Upsala, 21 July 1855. Having visited Germany and Italy in 1817–19, he formed ties of friendship with Schelling and Thorwaldsen; became instructor to Crown Prince Oscar, in 1820, and professor at the university in Upsala in 1828. He was unquestionably the foremost among the lyric poets of the romantic school in Sweden. His most celebrated work is 'The Isle of Blessedness' (1823), a romantic drama in the manner of Tieck; but he also wrote 'The Flowers,' a cycle of lyrics; 'The Blue Bird,' a play; and 'Swedish Seers and Poets,' a volume of criticism. His 'Collected Poems' appeared in 1854–63 and his 'Works' in 1870. Atterbom early came under German influence and founded the Aurora League which helped to liberate Swedish literature from French academic tradition.

ATTERBURY, Francis, English prelate: b. Middleton Keynes, England, 6 March 1662; d. Paris, 15 Feb. 1732. He distinguished himself at the university as a classical scholar, and gave proofs of an elegant taste for poetry. In 1687 he took his degree of M.A.; is thought to have assisted his pupil, Boyle, in his famous controversy with Bentley on the Epistles of Phalaris. Taking orders in 1691 he settled in London, where he became chaplain to William and Mary, preacher of Bridewell, and lecturer of Saint Bride's, and soon became distinguished by the spirit and elegance of his pulpit compositions, but not without incurring opposition, on the score of their tendency and doctrine, from Hoadly and others. Soon after the accession of Queen Anne he was made dean of Carlisle, and besides his dispute with Hoadly on the subject of passive obedience, he aided in the defense of the famous Sacheverell, and wrote 'A Representation of the Present State of Religion,' deemed too violent to be presented to the Queen, although privately circulated. In 1712 he was made dean of Christ Church, and in 1713 bishop of Rochester and dean of Westminster. The death of the Queen, in 1714, put an end to his hopes of further advancement; for the new king treated him with great coolness. Atterbury not only refused to sign the loyal declaration of the bishops in the rebellion of 1715, but suspended a clergyman for lending his church for the performance of divine service to the Dutch troops brought over to act against the rebels. Not content with a constitutional opposition, he entered into a correspondence with the Pretender's party, was

apprehended in August 1722, and committed to the Tower; and in the March following a bill was brought into the House of Commons for the infliction of pains and penalties. This measure met with considerable opposition in the House of Lords, and was resisted by the bishop, who maintained his innocence with his usual acuteness and dexterity. His guilt, however, has been tolerably well proved by documents since published. He was deprived of his dignities, and outlawed, and went to Paris, where he chiefly occupied himself in study, and in correspondence with men of letters. But even here, in 1725, he was actively engaged in fomenting discontent in the Highlands of Scotland. As a composer of sermons he still retains a great portion of his original reputation. His letters, also, are extremely easy and elegant; but, as a critic and a controversialist, he is deemed rather dexterous and popular than accurate and profound. Consult the 'Life' by Beeching (London 1909) and 'Memoirs and Correspondence,' edited by F. Williams (ib. 1869).

ATTERBURY, William Wallace, American railroad official: b. New Albany, Ind., 31 Jan. 1866. He began his railroad career as an apprentice in the Altoona shops of the Pennsylvania Railroad, after graduating from Yale University, in 1886. By 1896 he had risen to be general superintendent of motor power on the Pennsylvania lines east of Pittsburgh and Erie. In 1903 he became general manager of these same lines. In 1909 he was made 5th vice-president of the Pennsylvania Railroad corporation and transportation manager. Since 1911 he has been 4th vice-president.

ATTERIDGE, Andrew Hilliard, English journalist and author: b. Liverpool, England. He was educated at London University, Stonyhurst College and Louvain University. He became assistant editor of the *Month,* London, qualified as a specialist in military and naval subjects. He did special work in introducing cyclist infantry in the army and was a member of the staff of General Maurice in the first great cyclist manœuvres held in England. He was correspondent of the London *Daily Chronicle* at the manœuvres of the French, German and British armies; was war correspondent in the Dongola campaign of 1896, receiving a medal and clasp for the battle of Firket. He was military editor during the South African War and thereafter was for three years associated with an engineering firm, designing and building the experimental submarine *Volta* and carrying out experimental trials on the east coast of England. He has published 'Towards Khartoum' (1897); 'A Popular History of the Boer War' (1901); 'Napoleon's Brothers' (1909); 'Modern Battles from Alma to Mukden' (1910); 'The First Phase of the Great War' (1914); 'The British Army of Today' (1915); 'The German Army in War' (1915); 'The Second Phase of the Great War' (1915); 'The World-Wide War' (1915). He is a contributor to various periodicals and to 'The Catholic Encyclopedia.'

ATTERSEE, or **KAMMERSEE,** Austria, the largest lake in upper Austria. It is about 11 miles in length and in places attains a width of about two miles. its height above sea-level being 1,525 feet. The shores are rough and mountainous and extremely picturesque. Near the south end of the lake are the summer resorts Unterach and Weissenbach; on the north shore is the market town Schörfling, above which rises an ancient ruined castle and through which passes the railroad. Since 1869 the lake has been navigated by a small steamer.

ATTESTATION, the verification of an instrument, as a will, by the signature of a person or persons to a memorandum stating that it was executed in his or their presence. The purpose of the attestation is to furnish a record of the names of disinterested persons who were present at the execution of the document in order that they may later, if necessary, appear as competent witnesses to testify as to the attendant circumstances. In many States two attesting witnesses only are required to wills devising land, but in some States three are necessary. At common law deeds do not require attestation, but this has been modified largely by statute. See WILL.

ATTFIELD, John, English chemist: b. Hertfordshire 1835; d. 1911. From 1862 to 1896 he was professor of practical chemistry to the Pharmaceutical Society. He was one of the originators of the British Pharmaceutical Conferences. He is the author of 'Chemistry—General, Medical and Pharmaceutical' (19th ed., 1906); 'Water and Water Supplies' (three editions).

ATTIC, pertaining to Attica or to Athens. Elegant; classical; poignant; characterized by keen intellect, delicate wit, sound judgment and expressive brevity; as, the Attic Muse. Attic dialect was the most refined and polished of all the dialects of ancient Greece; and in it wrote Solon, the lawgiver; Thucydides and Xenophon, the historians; Aristophanes, the comic poet; Plato and Aristotle, the philosophers, and Demosthenes, the orator. When, after the Macedonian conquest, Greek became the language of literature and diplomacy in most parts of the civilized world, the Attic came to be that dialect of the Greek tongue which was generally adopted.

ATTIC MUSE, The, a title which has sometimes been applied to Xenophon because of the flowery style which is sometimes characteristic of his writing.

ATTIC ORDER, in architecture, a low order, commonly used over a principal order, never with columns, but usually with antæ or small pilasters. It is employed to decorate the façade of a story of little height, terminating the upper part of a building; and it doubtless derives its name from its resemblance in proportioned height and concealed roof to some of the buildings of Greece. In all the best examples, and especially in the remains of antiquity at Rome, the attic is decorated with a molded base and cornice; often with pilasters and figures, as in the Arch of Constantine. In modern architecture, the proportions of the Attic order have never been subject to fixed rules, and their good effect is entirely dependent on the taste and feeling of the architect. Attic base: The base of a column, consisting of an upper and lower torus, a scotia and fillets between them. Attic story: A term frequently applied to the upper story of a house, when the ceiling is square with the sides, to distinguish it from a garret.

ATTIC SALT, a term which is sometimes applied to the style of a piece of writing, to define a certain vigor, or keenness, which was supposed to be peculiar to the Athenians, as a contrast to the Acetum Italicum, or heavier style of the Romans.

ATTICA, a state of ancient Greece, whose capital, Athens, was once the first city in the world. It is a peninsula, united, toward the north, with Bœotia, toward the west, in some degree, with Megaris, and extends far into the Ægean Sea at Cape Sunium (now Cape Colonna). The unfruitfulness of its soil protected it against foreign invaders, and the Athenians boasted of their ancient and unmingled race. The earliest inhabitants of Attica lived in a savage manner until the time of Cecrops, who came 1550 B.C. with a colony from Sais, at the mouth of the Nile, to Attica, and is acknowledged as their first real king. One of Cecrops' descendants founded 11 other cities, which in after-times made war upon each other. Theseus compelled these cities to unite, and to give to Cecropia, now called Athens, as the capital city of the whole country, the supreme power over the confederacy. He founded the great feast called the *panathenæa,* watched over the administration of the laws, commanded the army, divided the whole people into three classes — noblemen, husbandmen and mechanics. He embellished and enlarged Athens, and invited foreigners to people the country. After the death of Codrus, 1068 B.C., the monarchical form of government, which had continued 487 years from the time of Cecrops, was abolished. An archon, chosen for life, possessed the regal power. After 316 years the term of office of the archons was limited to 10 years, and 70 years later to one year, and their number was increased to nine. A regular code of laws was now needed. The archon Draco was commissioned to draw one up; but his severity disgusted the minds of the people, and 594 B.C Solon introduced a milder code and a better constitution. He provided that the form of government should continue democratic, and that a senate of 400 members, chosen from the people, should administer the government. Pisistratus, a man of talents, boldness and ambition, put himself at the head of the poorer classes, and made himself master of the supreme power in Athens. His government was splendid and beneficent, but his two sons could not maintain it. Clisthenes, a friend of the people, exerted himself to prevent future abuses by some changes in the laws of Solon. He divided the people into 10 classes, and made the senate consist of 500 persons. Attica was already highly cultivated; the vintage and harvest, like all the labors of this gay people, were celebrated with dance and song, with feasts and sacrifices. Then came the splendid era of the Persian War, which elevated Athens to the summit of fame. Miltiades at Marathon, and Themistocles at Salamis, conquered the Persians by land and by sea. The freedom of Greece escaped the dangers which had threatened it; the rights of the people were enlarged; the archons and other magistrates were chosen from all classes without distinction. The period from the Persian War to the time of Alexander (500 B.C. to 336) was most remarkable for the development of the Athenian constitution. According to Böckh's 'The Public Economy of Athens,' Attica contained, together with the islands of Salamis and Helena, a territory of 847 square miles, with 500,000 inhabitants, 365,000 of whom were slaves. Cimon and Pericles (444 B.C.) introduced the highest elegance into Athens, but the latter laid the foundation for the future corruption of manners, and for the gradual overthrow of the state. Under him began the Peloponnesian War, which ended with the conquest of Athens by the Lacedæmonians. A more dangerous enemy rose in the north — Philip of Macedon. Athens, together with the other states of Greece, became dependent on the Macedonians. When they suffered themselves to be misled to support Mithridates against the Romans, they drew upon themselves the vengeance of Rome. Sulla captured the city, and left it only an appearance of liberty, which it retained until the time of Vespasian. This Emperor formally changed it into a Roman province. After the division of the Roman empire, Attica belonged to the empire of the East. In 396 A.D., it was conquered by Alaric the Goth, and the country devastated. Attica, along with the ancient Bœotia, now forms a nome or province (Attike and Viotia) of the kingdom. See ATHENS. Consult Frazer, J. G., 'Pausanias' Description of Greece' (new ed., London 1910); Gardner, E. A., 'Ancient Athens' (New York 1902); Kaupert and Curtius, 'Karten von Attika' (Berlin 1897); Leake, 'The Topography of Athens and the Demi of Attica' (London 1841); Wordsworth, Chr., 'Athens and Attica' (id. 1869).

ATTICA, Ind., city in Fountain County, on the Wabash River and Wabash and the Chicago & Eastern railroads, 21 miles southwest of Lafayette. It has numerous manufactories of proprietary medicines, bricks, etc., and contains churches, schools, banks and a public library. Attica was settled in 1827 and was incorporated in 1867. It was chartered in 1905 as a city, is governed by a mayor, chosen for four years, and a council. The city owns and operates the electric lighting plant. Pop. (1910) 3,335.

ATTICUS, Titus Pomponius, a noble Roman, the intimate friend of Cicero: b. 109 B.C.; d. 32 B.C. The Pomponian family, from which he originated, was one of the most distinguished of the *equites,* and derived its origin from Numa Pompilius. When he attained maturity, the republic was disturbed by the factions of Cinna and Sulla. His brother, Sulpicius, the tribune of the people, being killed, he thought himself not safe in Rome, for which reason he removed, with his fortune, to Athens, where he devoted himself to science. His benefits to the city were so great, that he gained the affections of the people in the highest degree, and acquired so thorough a knowledge of Greek, that he could not be distinguished from a native Athenian. When quiet was restored in Rome he returned and inherited from his uncle 10,000,000 sesterces ($500,000). His sister married the brother of Cicero. Cæsar treated him with the greatest regard, though he was known as a friend of Pompey. After the death of Cæsar, he lived in friendship with Brutus, without, however, offending Antony. In 32 B.C. being seized with an illness deemed incurable he starved himself to death. He wrote several works, including a history of Cicero's consulship, but none of his writings have been pre-

served. There is a life by Nepos and Cicero's 'Epistles to Atticus' give many facts concerning him.

ATTICUS HERODES, Tiberius Claudius, a wealthy Athenian: b. about 104 A.D.; d. about 180. He received a careful education under the most distinguished masters of the time, and specially devoted himself to the study of oratory, to excel in which seems to have been the ruling motive of his life, ultimately attaining to great celebrity as a speaker and as a teacher of rhetoric. Among his pupils were Marcus Aurelius and Lucius Verus. He was highly esteemed by the Antonines, particularly by Aurelius, and received many marks of favor, among others the archonship at Athens and the consulate at Rome. Atticus is principally celebrated, however, for the vast sums he expended on public purposes. He built a great race-course at Athens and a great musical theatre, called the Odeum, and which still exists. He also built a theatre at Corinth, a stadium at Delphi and baths at Thermopylæ. He withdrew from Athens, and resided at his villa near Marathon, where he died about 180 A.D. None of his writings are extant.

ATTILA, ăt'tĭ-lą (in German, *Etzel*), the son of Mundzuk, a Hun of royal descent, who followed his uncle, Roas, in 434, and shared the supreme authority with his brother, Bleda. These two leaders of the barbarians, who had settled in Scythia and Hungary, threatened the Eastern empire, and twice compelled Theodosius II to purchase an inglorious peace. The Huns themselves esteemed Attila their bravest warrior and most skilful general. Their regard for his person soon amounted to superstitious reverence, and being now sole master of a warlike people, his unbounded ambition made him the terror of all nations; and he became, as he called himself, the *scourge* which God had chosen to chastise the human race. In a short time he extended his dominion over all the people of Germany and Scythia, and the eastern and western emperors paid him tribute. The Vandals, the Ostrogoths, the Gepidæ and a part of the Franks united under his banners. Hearing a rumor of the riches and power of Persia, he directed his march thither, but was defeated on the plains of Armenia, and drew back to satisfy his desire of plunder in the dominions of the Emperor of the East. He easily found a pretext for war, for all states which promised him a rich booty were his natural enemies, and all princes whom he hoped to conquer had broken alliances. The Emperor Theodosius collected an army to oppose his progress; but in three bloody battles fortune declared herself for the barbarians. Constantinople was indebted to the strength of its walls, and to the ignorance of the enemy in the art of besieging, for its preservation. Thrace, Macedonia and Greece, all submitted to the savage robber, who destroyed 70 flourishing cities. Theodosius was at the mercy of the victor, and was obliged to purchase a peace. Attila now directed his eyes to Gaul. With an immense army he passed the Rhine, the Moselle and the Seine, came to the Loire, and sat down under the walls of Orleans. The inhabitants of this city, encouraged by their bishop, Agnan (Anianus), repelled the first attack of the barbarians, and the united forces of the Romans, under their general, Ætius, and of the Visigoths, under their King, Theodoric, compelled Attila to raise the siege. He retreated to Champagne, and waited for the enemy in the plains of Chalons. The two armies soon approached each other. Attila, anxious for the event of the battle, consulted the soothsayers, who assured him of a defeat. He concealed his alarm, rode through the ranks of his warriors, reminded them of their deeds, spoke of his joy at the prospect of a battle, and at the thought that their valor was to be rewarded. Inflamed by his speech, and by the presence of their leader, the Huns were impatient for battle. At length the ranks of the Romans and Goths were broken through, and Attila was already sure of the victory, when the Gothic prince, Thorismond, the son of Theodoric, poured down from the neighboring height upon the Huns. Attila, pressed on all sides, escaped with difficulty to his camp. This was perhaps the bloodiest battle which had been fought in Europe until the great conflict of 1914; for according to contemporary historians, 106,000 dead bodies covered the field of battle. Attila caused all his camp equipage and treasures to be brought together into a heap, in order to burn himself with them, in case he should be reduced to extremities. But the enemy were contented with collecting their forces during the night, and having paid the last honors to the dead body of King Theodoric (Dietrich), which they discovered with difficulty, they saluted his son, Thorismond, king upon the field of battle. Thus Attila escaped, but the Franks pursued him till he had passed the Rhine. He now demanded Honoria, the sister of Valentinian III, in marriage, and conquered and destroyed Aquileia, Padua, Vicenza, Verona, Bergamo, and laid waste the plains of Lombardy. The inhabitants fled to the Alps, to the Apennines and to the small islands in the shallows (lagoons) of the Adriatic Sea, where they built Venice. The Emperor had no army to oppose him; the Roman people and senate had recourse to tears and supplications. Pope Leo I went with the Roman ambassadors to the enemy's camp and succeeded in obtaining a peace. Attila went back to Hungary. The Romans looked upon their preservation as a miracle, and the old chronicles relate that the threats of Saint Peter and Saint Paul had terrified Attila—a legend which the art of Raphael and Alghardi has immortalized. Not having obtained Honoria for a wife, Attila would a second time have demanded her, sword in hand, if the beautiful Ildico had not been added to his numerous wives, with whom he solemnly united himself (453). On this occasion he gave himself up to all the extravagance of debauchery; but on the other day after the marriage, the servants and warriors, impatient to salute their master, thronged into the tent; they found Ildico veiled, sitting by the cold corpse of her husband. During the night he had died of a hemorrhage. The news of his death spread sorrow and terror in the army. His body was enclosed in three coffins—the first was of gold, the second of silver and the third of iron. The captives who had made the grave were strangled. The description that Jornandes has left us of this barbarian king reminds us of his Kalmuck-Tartar origin. He had a large head, a flat nose, broad shoulders, and a short and ill-formed body. Consult 'Cambridge Mediæval

History' (Vol. I, New York 1911); Gibbon, 'Decline and Fall of the Roman Empire' (London 1854–55); Thierry, 'Histoire d'Attila' (Paris 1874).

ATTIREST, ä-tē-rā, **Jean Denis**, French painter: b. Dôle, Franche-Comté, 1702; d. Peking, China, 1768. He first studied painting in Rome, then, at the age of 30, joined the Jesuits, by whom he was sent as a missionary to China. Here he attracted the attention of the Chinese Emperor, Lien Lung, who made him his court painter. Together with three other Jesuit missionaries, Damascenus, Sichelbarth and Castiglione, he executed 16 great historical paintings, illustrating the military campaigns of the Emperor against the Tartars. These were reproduced in France under the direction of Cochin in the form of engravings, but the plates were sent to the Emperor of China, only two sets of prints being retained; one for the royal family and another for the National Library. So potent was his influence as a painter in China that he founded a European school of painting among the Chinese. In 1754 he was honored by the Emperor with the offer of the title of mandarin, but this he refused.

ATTIS. See ATYS.

ATTLEBORO, Mass., town in Bristol County, 30 miles southwest of Boston, and 12 miles from Providence. It has good railroad connections, contains national banks, newspaper offices, several churches and a system of graded schools. The town is the seat of several important industries, the chief of which is the manufacture of jewelry and electro-plate. There are also manufactories of cotton, woolen and knit goods, and of boots and shoes. The United States census of 1914 reported 151 manufacturing establishments of factory grade, employing 6,950 persons, of whom 6,058 were wage earners, receiving $3,518,000 annually in wages. The capital invested aggregated $15,656,000, and the value of the year's output was $13,947,000; of this, $6,568,000 was added by manufacture. The government is administered by annual town meetings; and the waterworks are owned and operated by the municipality. The town was settled in 1669 and was originally a part of Rehoboth. It derived its name from Attleborough, England, and was incorporated as a town in 1694. Consult J. Dogget, 'A Sketch of the History of Attleborough' (Boston 1894). Pop. (1910) 16,215; (1914) 18,000.

ATTOCK, ăt-tŏk', India, a town and fort of the Punjab, on the east bank of the Indus. Attock stands below the fort, established by the Emperor Akbar in 1581, to defend the passage of the river. The great railway bridge across the Indus here was opened in 1883. It has five arches 130 feet high, and renders continuous the railway connection between Calcutta and Peshawur (1,600 miles). The situation of Attock is important, whether in a commercial or in a military view. It is at the head of the steamboat navigation of the Indus, being 940 miles from its mouth. Taxila, where the Macedonians crossed the Indus, has been identified with Attock. Pop. about 3,000.

ATTORNEY (*attornatus*, in Latin), a person appointed to do something for and in the stead and name of another. A public attorney or attorney at law is a person qualified to appear for another before a court of law to prosecute or defend any action on behalf of his client. The term was formerly applied especially to those practising before the supreme courts of common law at Westminster, and corresponded to the term solicitor used in regard to the courts of chancery. As an attorney was almost invariably a solicitor, the two terms came to be generally regarded as synonymous. By the Judicature Act of 1873 all persons practising before the supreme courts at Westminster are now called solicitors. Attorneys or solicitors do not plead or argue in court on behalf of their clients, this being the part of the barristers or counsel: their special functions may be defined to be, to institute actions on behalf of their clients and take necessary steps for defending them, to furnish counsel with necessary materials to enable them to get up their pleadings, to practise conveyancing, to prepare legal deeds and instruments of all kinds, and generally to advise with and act for their clients in all matters connected with law. An attorney, whether private or public, may have general powers to act for another; or his power may be special and limited to a particular act or acts. In Scotland there is no class of practitioners of the law who take the name of attorneys. A special attorney is appointed by a deed called a power or letter of attorney, and the deed of which he is appointed specifies the acts he is authorized to perform. It is a commission, to the extent of which only he can bind his principal. As far as the acts of the attorney, in the name of the principal, are authorized by his power, his acts are those of his principal. But if he goes beyond his authority, his acts will bind himself only; and he must indemnify any one to whom, without authority, he represents himself as an attorney of another, and who contracts with him, or otherwise puts confidence in him, as being such attorney. Consult Weeks, 'Treatises on Attorneys and Counselors at Law' (San Francisco 1892). See AGENT.

ATTORNEY, Power of, which may be limited or general. A general power of attorney is an instrument by which one person confers on another person full and unlimited authority to act as his representative or agent. A limited power of attorney specifies the special business on which the agent is authorized to act. Under the law a power of attorney cannot be extended to a third person, without such action being provided for in the instrument itself. The death of the principal, the person who grants the power of attorney, renders it at once void. See ATTORNEY.

ATTORNEY AT LAW, an officer of a court of justice employed by a party in a cause to manage it for him. Appearance by attorney has been allowed in England from the time of the earliest records of the courts of that country. Such appearances were first allowed in France by letters patent of Philip le Bel 1290 A.D. No one can, by consent, be the attorney of both the litigating parties in the same action or suit. The agreement of an attorney at law, within the scope of his employment, in general, binds his client (1 Salk. 86) as to amend the record, to refer a cause, not to sue out a writ of error, to strike out a *non pros*, to waive a judgment by default, etc. The principal duties of

an attorney are to be true to the court and to his client, to attend to the business of his client with prudence, skill and honesty (4 Burr. 2061, 72 Ga. 83); to keep his client informed as to the state of his business, and to keep his secrets confided to him as such, and an attorney is privileged from disclosing such secrets when called as a witness (16 N. Y. 180, 29 Vt. 701). An attorney is allowed considerable freedom of speech, and, ordinarily, is not liable for the use of false, defamatory or malicious language, provided it was material to the issues raised by the pleadings (Hastings *v.* Lusk, 22 Wend. N. Y. 410). He is liable, however, if his language is defamatory, if it can be shown that it was not relevant to the issues, and was used for the purpose of injuring the character of his adversary (1 Barn. & C. 258).

ATTORNEY-GENERAL, the official legal adviser of a nation or state and the head of its legal department.

Attorney-General of the United States. — In the United States the office of Attorney-General was created by the Judiciary Act of 1789; from the beginning this officer was a member of the cabinet, appointed by the President, and under the provisions of the Act of Congress of 19 Jan. 1866, he is fourth in succession, after the Vice-President, to the office of President should a vacancy occur in that office. He is required by statute to give his advice and opinion upon questions of law when required by the President, and, upon request, to give his opinion to the head of any executive department on any question of law arising in his department and to interpret for the department heads the statutes under which they act; but while he may furnish information to Congress, he does not render opinions to that body or any of its committees. He passes on the validity of the title to public lands purchased for the erection of public buildings by the United States; he exercises general superintendence and direction over attorneys and marshals of all the districts of the United States and Territories as to the manner of discharging their respective duties and over the government penal and reformatory institutions, also advising the President regarding pardon matters. Before signing certain classes of bills the President usually consults the Attorney-General and also confers with him regarding the appointment of judges and officers of the courts. To him are referred questions involving the interpretation of the Constitution and any opinions rendered by his subordinates regarding matters of minor importance are subject to his approval. He does not determine questions of fact nor pass upon questions in controversy before the courts; he does not answer hypothetical questions nor are his decisions subject to review. The published opinions of the Attorney-General have come to be regarded almost as authoritative as court decisions and constitute a body of precedents that have assumed a quasi-judicial character.

As the government's chief advocate the Attorney-General conducts and argues all cases in which the United States is concerned, whenever he deems that the interests of the country require his personal attention; he appears at times in the Supreme Court, but rarely in the inferior courts. If the United States should have an interest in a suit between States, he may appear in order to introduce evidence or argument but not in a manner to make the national government a party to such suit. While suits may not as a matter of right be instituted against the United States, certain classes of claims may be prosecuted in special courts created for that purpose or by laws regarding minor claims, and the Attorney-General exercises general jurisdiction over such courts.

The State Attorney-General. — In a few States the attorney-general is appointed by the governor or by joint ballot of both branches of the legislature, but in most of the States he is elected by popular vote. The term of office varies from one to four years, the tendency being toward the longer period, but in some cases the term of attorney-general does not coincide with that of the governor. He may be removed by impeachment or in a few cases by special process, as in New York, where on the recommendation of the governor he may be removed by a two-thirds vote of the senate; but nowhere can he be removed save for cause and on the preferring of charges, against which he shall be given an opportunity to defend himself.

As a rule all the powers and duties of the attorney-generals are not enumerated and defined by the statutes of the various States and, therefore, so far as applicable to our altered situation, jurisprudence and system of government, they are clothed with the common-law powers of the attorney-generals of England. The attorney-general is required, upon request, to render to the governor, legislature, department heads and other State officers, opinions upon questions of law pertaining to their work. He prosecutes offenders against State laws and defends State officers if they be sued in their official capacity; he also appears in Federal and State courts on behalf of the State in any case in which it may be interested or to which it is a party. He may also serve on various State boards. Owing to the confusion arising from the employment of special counsel by State boards and commissioners, many States have prohibited this and require that the attorney-general shall conduct all the legal work of the State or at least have general supervision over it. In New York, however, irrespective of the attorney-general, the governor may appoint a person to investigate any State department or institution.

The Local Prosecuting Attorney.—In each county or local district into which a State may be divided for this purpose is an officer called the district attorney, prosecuting attorney or State's attorney, who has charge of the State's legal business in that locality. He is elected by the people of this county or district usually for a term of two or four years, and may be removed from office only after the completion of certain judicial or quasi-judicial proceedings. In New York and Minnesota he may be removed by the governor alone after having had the opportunity of defending himself against the charges preferred. The governor's power is executive and not reviewable by the courts. In some States *quo warranto* proceedings may be instituted in the State Supreme Court by the attorney-general. The district attorney is required to advise county officials

upon legal questions concerning their official duties, and to advise the grand jury; he examines witnesses, draws up indictments and prosecutes all actions, civil and criminal, in the County Courts in which either the State or county may be interested or a party. While the State attorney-general may advise the prosecuting attorneys as to their duties, he seldom possesses power of actual direction over them and is often embarrassed by a difference of opinion as to the enforcement of State laws in local districts. In some States there is no remedy, but in New York prosecuting attorneys may be removed from office, and in Pennsylvania these officials may be superseded by officers of central appointment and control. See also COURT; JUDICIARY; LAW, ADMINISTRATIVE; LAW, CRIMINAL.

The British Attorney-General.— In England the Attorney-General is appointed by letters patent and holds office during the King's pleasure. He is the chief law officer of the Crown, and ex officio the leader of the bar having precedence in all courts and in the House of Lords even of the lord advocate. The Attorney-General and Solicitor-General are members of the House of Commons, and also of the ministry, usually being chosen from the party in power, save, perhaps, in the case of a coalition ministry. In Scotland (where he is called lord advocate), Ireland and almost all the colonies, there are attorney-generals in self-governing colonies; they are appointed by the colonial administrations and in the Crown colonies by royal warrant. The duchies of Cornwall and Lancaster have attorney-generals who manage legal affairs in those localities. The most important duties of the British Attorney-General are to exhibit informations and prosecute for the Crown in matters criminal, and to file bills in the exchequer in any manner concerning the King's revenue. The Attorney-General of England has the power (1) to prosecute all actions necessary for the protection and defense of the property and revenues of the Crown; (2) by information to bring certain classes of persons accused of crimes and misdemeanors to trial; (3) by "*scire facias*" to revoke and annul grants made by the Crown improperly, or when forfeited by the grantee thereof; (4) by information, to recover money or other chattels or damages for wrongs committed on the land, or other possessions of the Crown; (5) by writ of *quo warranto*, to determine the right of him who claims or usurps any office, franchise or liberty, and to vacate the charter, or annul the existence of a corporation for violations of its charter, or for omitting to exercise its corporate powers; (6) by writ of mandamus to compel the admission of an officer duly chosen to his office, and to compel his restoration when illegally ousted; (7) by information to chancery, to enforce trusts, and to prevent public nuisances, and the abuse of trust powers; (8) by proceedings *in rem*, to recover property to which the Crown may be entitled, by forfeiture for treason, and property for which there is no other legal owner, such as wrecks, treasure trove, etc.; (9) and in certain cases, by information in chancery, for the protection of the rights of lunatics and others who are under the protection of the Crown.

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IRVING E. RINES.

ATTORNMENT, a formal recognition by a tenant, of the grantee of the freehold as his landlord. Formerly this assent was manifested by words, by agreement in writing, by the payment of rent or of a nominal sum. Without such attornment the grantee was not entitled to the rents of the tenant, and could not enforce against the tenant any covenant or condition of the tenancy. In the course of time the law was so modified as to dispense with attornment in ordinary cases of conveyance, such conveyance being regarded effectual from its date, the tenant becoming the tenant of the grantee according to the terms of the existing lease. The tenant, however, is not liable on the obligations of his lease to the new owner until notified of the conveyance. Consult Kent, 'Commentaries on American Law' (Boston 1896); Taylor, 'Treatise on the American Law of Landlord and Tenant' (9th ed., Boston 1904); Tiffany, 'The Law of Landlord and Tenant' (Saint Paul 1910).

ATTRACTION, in physics, any force acting between two bodies, which tends to bring them nearer together, or to oppose their further separation. All attractions can be divided into two classes: (1) Those which act at sensible distances, such as gravity and magnetism, and (2) those which exert measurable effects only when the bodies are exceedingly close together. Cohesion and molecular forces are examples of the second class. See COHESION; ELECTRICITY; ETHER; GRAVITATION; MAGNETISM; MOLECULAR THEORY; SURFACE TENSION.

ATTRIBUTE, in philosophy, a quality or property of a substance, such as whiteness or hardness. A substance is known to us only as a congeries of attributes. In the fine arts an attribute is a symbol regularly accompanying and characterizing some personage. Thus the caduceus, purse, winged hat and sandals are attributes of Mercury, the trampled dragon an attribute of Saint George, the keys of Saint Peter, etc.

ATTRITION, a disposition of the soul which consists in sorrow for sin springing from a salutary fear of its consequences. Theologians of the Catholic Church teach that such sorrow joined to the absolution of the priest in the Sacrament of Penance is sufficient for the remission of sin, although the penitent is counseled to strive for the more perfect sorrow (contrition), which has for its motive the love of God. See CONTRITION.

ATTU, or **ATTOO**, one of the islands of the Aleutian group, being the outermost of the chain, therefore the most westerly point of United States home territory. It is extremely rugged and rocky, its highest elevation being over 3,000 feet above sea-level. The population is about 400, all of which are natives. Some excavations have been carried on in the island which have resulted in throwing some light on the movements of the early races that are supposed to have migrated from Asia to America.

ATTUCKS, Crispus, the first man to fall in the Boston Massacre, 5 March 1770. He was born in Framingham, Mass., either of an Indian or Negro mother, in about 1720. A statue to his memory has been erected on Boston Common. The accounts vary as to his participation in the disturbance, some stating that he was a mere spectator, others that he was one of the chief rioters. Consult 'American Historical Record' (1872) and Kidder, 'History of the Boston Massacre' (Albany 1870).

ATWATER, Wilbur Olin, American chemist: b. Johnsburg, N. Y., 3 May 1844; d. Middletown, Conn., 22 Sept. 1907. He was graduated at Wesleyan University in 1865; made a special study of chemistry in the Sheffield Scientific School of Yale and the universities of Leipzig and Berlin. He was successively professor of chemistry in East Tennessee University, Maine State College and Wesleyan University. He was director of the Connecticut Agricultural Experiment Station, 1875–77, and was appointed director of the Storrs (Conn.) Experiment Station in 1887. He was connected for several years with the United States Department of Agriculture; published a large number of papers on chemical and allied subjects; and after 1894 gave much attention to nutrition investigations. He wrote extensively on agricultural and physiological chemistry, including 'An Experimental Enquiry Regarding the Nutritive Value of Alcohol' and several bulletins of the office of experiment stations of the United States Department of Agriculture.

ATWILL, Edward Robert, American bishop: b. Red Hook, N. Y., 18 Jan. 1840; d. 1911. He was graduated from Columbia University in 1862, and at the General Theological Seminary, 1864. He was rector of Saint Paul's Church, Burlington, Vt., 1867–80; of Trinity Parish, Toledo, Ohio, 1881–90; and was consecrated first Protestant Episcopal bishop of west Missouri, 14 Oct. 1890.

ATWOOD, Charles B., American architect: b. Millbury, Mass., 18 May 1849; d. Chicago, 19 Dec. 1895. He studied at the Harvard Scientific School, and opened an office in 1872. Within three years he received prizes for designs for the San Francisco city hall, the Connecticut State capitol, the courthouse in Springfield, Mass., and a commission to build the Holyoke, Mass., city hall. Removing to New York in 1875, he designed residences for W. H. Vanderbilt, Elliot F. Shepard and W. D. Sloane, and interior decorations for the houses of Mrs. Mark Hopkins in San Francisco and Great Barrington, Mass. In 1884 he gained the first prize for a design for the Boston Public Library, and later a prize of $5,000 for plans for a new city hall in New York city. From 1891–93 he was associated with D. H. Burnham in planning the World's Fair buildings in Chicago. The art building (now the Columbian Museum), peristyle, service building and many minor features were from his designs. He was a close student of his art, and a marvelous draughtsman, using his left hand with sureness and rapidity. D. H. Burnham said of him, "He was of an honorable, charitable disposition, but like most great artists, a mere child in the practical things of life."

ATWOOD, George, an eminent English mathematician: b. London 1746; d. 11 July 1807. He was graduated at Trinity College, Cambridge, in 1769, where he was also fellow and tutor. He was elected to the Royal Society in 1776. Through the aid of William Pitt he secured a position in the customs service, where he made several important calculations in connection with the revenue. In 1774 he published 'Treatise on the Rectilinear Motion and Rotation of Bodies; with a Description of Original Experiments relative to that Subject'—a work remarkable for its perspicuity and the extensive information which it affords. About the same time he made public an 'Analysis of a Course of Lectures on the Principles of Natural Philosophy,' read at the University of Cambridge, which is not less valuable than the preceding. He published a 'Dissertation on the Construction and Properties of Arches' (1801), and several other valuable treatises relating to mathematics and mechanical science. He invented a machine still used in physical lecture-rooms, which affords great facilities for verifying the laws of falling bodies. See ATWOOD'S MACHINE.

ATWOOD, Isaac Morgan, American Universalist clergyman, editor and educator: b. Pembroke, N. Y., 24 March 1838; d. Washington, D. C., 26 Oct. 1917. Educated in common schools and academies he was ordained to the Universalist ministry in 1860. He held pastorates in Churchville, Clifton Springs and Watertown, N. Y.; in Portland, Me., and in Brockton, Chelsea and Cambridge, Mass. He became editor of the Boston *Universalist* in 1867; of the *Christian Leader* in New York in 1872; was associate editor of the *Universalist Leader,* Boston, 1874–1909; and one of the contributors to the *Independent* for several years. Elected president of the Canton Theological School, 1879; he was appointed general superintendent of the Universalist Church in 1899; general secretary in 1905; became minister of the Canton Universalist Church and professor of systematic theology in the theological department of Saint Lawrence University in 1911. Author of 'Have We Outgrown Christianity?' (1870); 'Glance at Religious Progress in a Hundred Years'; 'Latest Word of Universalism' (1879); 'Walks About Zion' (1880); 'Episcopacy' (1885); 'Manual of Revelation' (1893); 'System of Christian Doctrines' (1900); and also a great many encyclopedic articles. He received the following degrees: A.M., Saint Lawrence University, 1869; D.D., Tufts College, 1879; LL.D., Buchtel College, 1905.

ATWOOD, Julius Walter, American clergyman: b. Salisbury, Vt., 27 June 1857. He was graduated from the Episcopal Theological School at Cambridge and in 1883 was ordained priest of the Protestant Episcopal Church, after which, until 1907, he was rector at Ipswich, Mass., Providence, R. I., and Phœnix, Ariz. At the end of that period he became archdeacon of the diocese of Arizona, being consecrated deacon in 1911. He is the author of 'The Spiritual Influence of John Greenleaf Whittier' (1893).

ATWOOD, Melville, Anglo-American geologist: b. Prescott Hall, England, 31 July 1812; d. Berkeley, Cal., 25 April 1898. He studied lithology, microscopy and geology early in life, and engaged in gold and diamond mining in Brazil. In 1843 he made a discovery that

greatly enhanced the value of zinc ore. After coming to the United States, in 1852, he invented the blanket system of amalgamation. He also established the value of the famous Comstock silver lode, by an assay of minerals in that region.

ATWOOD'S MACHINE, an instrument devised by George Atwood, an English physicist, for illustrating the principles governing the motion of falling bodies, and described by him in a book published in 1784. It consists essentially of a light wheel or pulley, over which a thin, flexible cord passes. A mass of matter is attached to each end of the cord, and the experiment consists in observing the velocity acquired by the system at the end of a given time. The mass to be moved is evidently the sum of the two masses attached to the ends of the cord (assuming that the wheel is light enough to be disregarded); and the force tending to set the system in motion is the difference of the weights of the two masses. By making these masses nearly equal, the motion can be made slow enough to be conveniently studied. The intensity of gravity can be determined by the aid of this machine, with sufficient accuracy for class-room purposes, and it is an admirable device for illustrating the laws of uniformly accelerated motion.

ATYS, ā'tis, or **ATTIS.** (1) The favorite of Cybele, who, having broken the vow of chastity which he made to the goddess, castrated himself, as a punishment for his crime. Consult Frazer, J. G., 'Adonis, Attis, Osiris' (London 1906), and Showerman, 'Great Mother of the Gods' (Madison, Wis., 1901). (2) A son of Crœsus, King of Lydia — an affecting example of filial love. He was dumb, but, seeing a soldier in a battle who had raised a sword against his father, he exerted himself so much that the bands of his tongue gave way, and he cried out, "Soldier, kill not Crœsus!"

AUBANEL, ō-bā-nĕl', **Théodore,** French poet, sometimes called "The Petrarch of France": b. 1829; d. 1886. He was the son of a printer of Avignon, and for years followed his father's profession. He devoted his life to the restoration of the troubadour literature. He was a collaborator of Mistral, Roumanille and other félibres. His drama, 'Lou Pan don Pecat,' was successfully staged in 1878 at Montpellier.

AUBE, Jean Paul, French sculptor: b. Longwy, Meurthe-et-Moselle, 1837. He studied art at the Beaux-Arts, under Duret and the elder Dauban. His works are found in many of the public places of the city of Paris. Among the more important ones are 'Bailly,' a bronze statue in the Luxembourg Gardens; 'Gambetta,' in the Place du Carrousel, Paris; 'Général Joubert à Rivoli,' at Bourges and 'France and Russia,' a decoration, in the Luxembourg.

AUBE, ōb, a French department, formed out of the south of Champagne and a small portion of Burgundy; area, 2,351 square miles. The north and northwest districts are very bleak, bare of trees, and almost destitute of vegetation; the southern districts are remarkably fertile. Grain, hemp, vegetables and wine are produced in large quantities. The forests, which are extensive, furnish much fuel for the supply of Paris. The chief manufactures are worsted and hosiery. Troyes is the capital. Pop. (1911) 240,755.

AUBENAS, ōb'nàs', France, town in the department of Ardèche, 19 miles southwest of Privas. It is beautifully situated on the right bank of the Ardèche, but its streets generally are crooked and narrow. It has a castle of the 16th century, now occupied by several of the public institutions of the town. These include a tribunal and chamber of commerce, and a conditioning-house for silk. Iron and coal mines are worked in the vicinity. As the centre of the silk trade of southern France Aubenas is a place of considerable traffic. It has also a large silk spinning and weaving industry, and carries on tanning and various minor industries together with trade in silk. The district is rich in plantations of mulberries and olives. Pop. about 4,000.

AUBER, ō-bār, **Daniel François Esprit,** French composer: b. Caen 1782; d. Paris 1871. His father was a violinist of some note, and also dealt in prints. He sent his son to England to learn the trade; but the latter's love for music triumphed and he returned to Paris in 1804, and attracted considerable attention through several musical compositions. He came under the notice of Cherubini, who gave him instruction in composition. His 'Le séjour militaire' appeared in 1813 but met an unfavorable reception. 'Le testament et les billet-doux' (1819) was equally unsuccessful, but 'La bergère châtelaine' (1820), a comic opera, was well received, established his fame, which he sustained in the 40 other works which appeared in rapid succession until his death. Among these the most noteworthy were 'Le maçon' (1825); 'La muette de Portici' (1828), his most serious opera and perhaps his greatest; 'Fra Diavolo' (1830); 'Le philtre' (1831); 'Le cheval de bronze' (1835); 'Le domino noir' (1837); 'Le lac des fées' (1839); 'Les diamants de la couronne' (1841). In 1829 he succeeded Gossec at the Academy, was appointed director of the Conservatory in 1842, and court chapel master to Napoleon III in 1857. He is regarded as the founder of French grand opera. For polish, melody, brilliant orchestration and formal structure his work stands among the greatest. Consult Kohut, A., 'Auber' (Leipzig 1895); and Malherbe, C., 'Auber, biographie critique' (Paris 1911).

AUBER, Harriet, English poetess and hymnwriter: b. London, 4 Oct. 1774; d. Hoddlesdon, 20 Jan. 1862. She led a very quiet life. She published 'The Spirit of the Psalms' (1829). Some 25 of her hymns from this book have been more or less in use. When Charles H. Spurgeon compiled 'Our Own Hymnbook' (1866) he included 20 hymns written by Miss Auber. Three are included in the edition of the 'Methodist Hymnal' in present use. The best known of her hymns is the one beginning "Hasten Lord, the glorious time, When beneath Messiah's sway." Another widely used hymn by Miss Auber begins "Our blest Redeemer ere he breathed."

AUBERGE ROUGE, L', lō bārzh-roozh ("The Red Inn"), a romance published by Balzac in 1831, appearing first in the *Revue de Paris*. The narrator of the story is in love with the daughter of a man whom he knows to have committed a murder for robbery and from

which he has acquired a considerable fortune. Unable to settle the doubts in his own conscience as to whether he should marry the girl and so come into the possession of the ill-gotten money, he invites 17 of his friends to dinner, representing all classes of social opinion, tells them the story and asks them to vote on the question. The vote is almost a tie, nine being against the marriage. Nevertheless he marries the girl.

AUBERLEN, ou-bĕr-lĕn, **Karl August,** German theologian: b. Fellbach, near Stuttgart, 1824; d. Basel, Switzerland, 1864. He studied at Tübingen, where he was strongly influenced by the teachings of Ferdinand Christian von Baur, whose pupil he was. Later in life he held views of a more conservative nature than those of Baur's Tübingen school. In 1851 he was appointed professor of theology at Basel. His chief work is 'Die Theosophie Otingers nach ihren Grundzügen' (2d ed., Basel 1856). His other important works are 'Der Prophet Daniel und die Offenbarung Johannis' (1874), and 'Die göttliche Offenbarung' (1864).

AUBERT, ōbār', **Jean Louis, Abbé,** French writer: b. Paris 1731; d. there, 10 Nov. 1814. He first attracted attention by his 'Fables,' which were published in the *Mercure de France* and brought forth high praise from Voltaire. From 1773 to 1784 he was professor of French literature in the Royal College, during which period he was also managing editor of the *Gazette de France.* At one time he was the official censor of the government. A collection of his works appeared under the title 'Fables et œuvres diverses' (1775).

AUBERT, Louis François Marie, French composer: b. Parame, 15 Feb. 1877. Already at an early age he showed indications of musical talent and at the age of nine he was studying at the Paris Conservatory under Diemer and Fauré. He has composed various collections of songs, a fantasie for piano and orchestra (1901) and the opera 'La Forêt Bleue' (1906), which was produced by the Boston Opera Company in America in 1913.

AUBERVILLIERS, ō'bār've'yā', France, city in the department of Seine, on the canal Saint Denis, two miles from the right bank of the Seine, and one mile north of the fortifications of Paris. Its manufactures include cardboard, glue, oils, colors, fertilizers, chemical products, perfumery, etc. During the Middle Ages and till modern times Aubervilliers was the resort of pilgrims, who came to pay honor to Notre Dame des Vertus. In 1814 the locality was the scene of a stubborn combat between the French and the Allies. Pop. about 33,000.

AUBIGNAC, ō-be-nyak, **François Hédelin, Abbe d',** French dramatist: b. Paris, 4 Aug. 1604; d. 25 July 1676. He was the tutor of Richelieu's nephew and was later made abbé of Aubignac, under which name he became more generally known. His chief works are a tragedy in prose, 'Zenobie,' and 'Pratique du théâtre' (1657), in which he, for the first time, codified the laws of dramatic method and construction. He is chiefly remembered as the first to raise the question as to the authorship of the poems of Homer.

AUBIGNÉ, D', J. H. M. See D'Aubigné, J. H. M.

AUBIGNE, ō'be-nyā', **Theodore Agrippa d',** French soldier and author: b. Saint Maury (Saintonge), 8 Feb. 1552; d. Geneva, 29 April 1630. Early in life he embraced the Huguenot cause, was condemned to death but escaped and was sent by his guardian to Geneva for safety. In 1567 he enlisted under Condé. He fought under King Henry IV, King of France, who made him a gentleman of his bedchamber; but when the King, thinking it necessary, favored the Roman Catholics more than the Protestants, Aubigné expressed his displeasure with little reserve, and lost the favor of Henry. He now retired to Geneva, where he devoted himself to literary pursuits. He produced much of value to literature and to the history of his time. He wrote a valuable 'Histoire Universelle, from 1550 to 1601' (3 vols. folio), the first volume of which was ordered to be burned by the Parliament of Paris. A volume of sonnets and other poems, under the title 'Le Printemps,' also bears his name. The group of satirical poems 'Les tragiques' (1616) is his greatest work. It contains sombre descriptions of the religious warfare of the time. His complete works were edited by Réaume and Caussade (6 vols., 1873–93), the 'Tragiques' by Lalanne (1857) and Reade (1872); 'L'Histoire universelle' by Ruble (1897). Consult Guizot, G., 'Agrippa d'Aubigné' (Paris 1890); Macdowell, 'Henry of Guiso and Other Portraits' (New York 1898); Morillot, 'Discours sur la vie et les œuvres d'Agrippa d'Aubigné' (Paris 1885); Rocherlave, 'Agrippa d'Aubigné' (Paris 1910).

AUBLET, ō-blā', **Albert,** French painter: b. Paris 1851. He studied historical painting under Gerome; won a first-class medal in the Paris Exposition of 1889, and the decoration of the Legion of Honor in 1890. His first great painting was 'The Wash-room of the Reserves in the Cherbourg Barracks,' exhibited in the Salon of 1879, and probably his most celebrated one is the 'Meeting of Henri III and the Duc de Guise,' shown in the Salon of 1880. He is a chevalier of the Legion of Honor.

AUBREY, â'brĭ, **John,** English antiquary: b. Easton Pierse 1626; d. 1697. He published little, but left large collections of manuscripts, which have been used by subsequent writers. He collected materials for the 'Monasticon Angelicanum,' and afforded important assistance to Wood, the Oxford antiquary. His 'Miscellanies' (1696) contains a great deal of curious and interesting information, but also displays much credulity and superstition. Another work of his was published in 1719 under the title of the 'Natural History and Antiquities of the County of Surrey.' In 1898 appeared a work by him entitled 'Brief Lives Chiefly of Contemporaries,' edited by Andrew Clark. Consult biography by J. Britton (London 1845) and essay by Masson in *British Quarterly Review* (Vol. XXIV, London 1857).

AUBRIOT, ō'bre-ō, **Hugues,** a mayor of Paris, who figures frequently in French history. He was born in Dijon and died about 1382. He is first heard of as treasurer under Charles V. In 1364 he became mayor and governor of Paris. Under his administration some of the greatest public works were initiated. He laid

the cornerstone of the Bastile and he was responsible for the building of the Pont Saint-Michel, Le Petit Chatêlet and the completion of some of the most important fortifications of the city. Later he is heard of as being accused of heresy and was confined in his own bastile. His sculptural likeness may be found to-day on the façade of the Hôtel de Ville of Paris. Consult Eugene Déprez, 'Hugo Aubriot, Præpositus Parisiensis et Urfanus Prætor, 1367–81' (Paris 1902).

AUBRY, ō'brē', **Charles Marie Barbe Antoine**, French jurist: b. Zabern, Alsace, 20 June 1803; d. Paris, 13 March 1883. In 1870 he was assistant judge of the tribunal at Strassburg. In 1872 he became councillor of the Court of Cassation in Paris, a position he held until 1878. In that same year he was made a commander of the Legion of Honor. Aside from his writings on jurisprudence, which rank very high, he made a translation of Goethe's 'Faust.' His chief work is 'Cours de droit civil français d'après la méthode de Zachariæ' (8 vols., Paris 1869–76).

AUBRY DE MONTDIDIER, moṅ-dē' dejā, French knight under Charles V, supposed to have been murdered by Richard de Macaire in 1371. The story is that the assassin was suspected on account of the fierce animosity the dog of the murdered man showed toward him and that the King ordered him to engage in a combat with the animal. The result was that the dog killed the man, becoming famous as "Aubry's Dog," under which title the story became a popular play. Other versions were dramatized, though always with the same general features, one of these plays, a popular melodrama, being presented as late as 1816. This last play was translated into German and presented in Vienna and Berlin and appeared at the Weimar Theatre in 1817, of which Goethe was manager, the leading rôle being played by a large poodle.

AUBURN, Ala., town in Lee County, 60 miles northeast of Montgomery, on the Western of Alabama Railroad. The Alabama Polytechnic Institute, founded 1872, is located here. There is a Carnegie library. Pop. 1,408.

AUBURN, Cal., city and county-seat of Placer County, situated on the Southern Pacific Railroad, 36 miles east of Sacramento. It was first settled in 1849 and was incorporated as a city in 1888. It is the seat of the Sierra Normal College. Gold and quartz is found in the vicinity and there are many quartz mills. The leading industries are mining, fruit-growing and farming. Pop. (1910) 2,376.

AUBURN, Ind., city and county-seat of De Kalb County, situated on branches of the Lake Shore & M. S. and the Baltimore & O. railroads, 22 miles north of Fort Wayne. It has a thriving trade in grain, live stock, etc., and its chief manufactures are furniture, carriages, automobiles, gas engines, windmills and stoves. Auburn was first settled in 1833, became a borough in 1836 and a city in 1900. The mayor and other officials are elected biennially. The buildings of note are the city hall, the Y. M. C. A. Building, the Eckhart public library and the county buildings. The waterworks and electric plant are owned and operated by the municipality. Pop. (1910) 3,919.

AUBURN, Me., a city and county-seat of Androscoggin County, on the west bank of the Androscoggin River, on the line of the Maine C. and Grand Trunk railroads, 34 miles north of Portland. The city is one of the most beautiful in the State. It rises westerly from the river in almost amphitheatre form, culminating in beautiful heights known as the Western Promenade. These heights are terraced by broad, handsome avenues, upon which, overlooking the city, are elegant residences with spacious and well-kept grounds. The view from the summit of these heights is one of the most striking in Maine. The beautiful Androscoggin River, with its waterfall grand and picturesque, flows through the valley below, the two thriving cities of Auburn and Lewiston on either bank, while broad and fertile fields dotted with comfortable farm homes stretch to the north and east. Taylor Pond and Lake Auburn lie to the west and are justly considered among the most beautiful lakes of Maine. The territory of the city covers an area of 65.4 square miles.

History.— Auburn is an old town and has an interesting history. Its territory is a part of a large tract of land, originally known as Bakerstown, granted by the general court of Massachusetts in 1765. It was settled as early as 1786 and Auburn was incorporated as a town in 1842, and as a city in 1869.

Industries.— Its largest single industry is the manufacture of boots and shoes, and in this branch of manufacture it is one of the foremost cities in the country. Its industries include cotton mill, last, box and carriage factories, machine shops, shoe findings, dairy products, beef and packing houses, marble and foundry products, lumber, shuttles and spools. The United States census of manufactures for 1914 recorded 84 establishments of factory grade, employing 5,247 persons, of whom 4,811 were wage earners, receiving $2,855,000 annually in wages. The capital invested aggregated $6,020,000, and the year's output was valued at $13,840,000; of this $5,154,000 was added by manufacture.

Banks.—There are two national banks and two savings banks located here. The capital stock of the two national banks is $350,000; surplus, $138,378. The deposits in the savings banks, about $2,500,000.

Government.— The commission form of government has been put in operation and has proved much more satisfactory than the old form of municipal government with a mayor, a board of aldermen and a board of common councilmen. The city owns its waterworks. The assessed valuation of the real and personal property according to latest obtainable reports is $11,026,007; rate of taxation 20 mills; bonded debt $462,700; floating debt $46,500.

Churches and Schools.— The city has nine churches, one of them organized as early as 1807, supported by the following denominations: Baptist, Free Baptist, Universalist, Episcopal, Methodist, Congregational and Catholic. The city has a school population of about 5,000. School accommodations are furnished absolutely free from the kindergarten to the completion of the high school course. Excellent buildings, commodious, well appointed and equipped with modern improvements are distributed over the city sufficient for the full accommodation of

all the pupils in the primary, intermediate, grammar and high school grades. At the head of the public school system stands the Edward Little High School, a noted institution having its origin in the old Lewiston Falls Academy, incorporated in 1834. In addition to the public schools there is a Catholic parochial school of 564 scholars, supported solely by the Catholic portion of the population. There is also an excellent free public library. The city, generally speaking, is thriving and prosperous. Its population is composed largely of skilled workmen who own their own homes and are permanent residents. The streets are wide and well paved, regularly laid out, and in the residential sections adorned with beautiful shade trees. There is an excellent and extensive electric street railway, two large and centrally located hotels, a beautiful public park, a handsome and commodious set of county buildings in which are located the Supreme Court rooms and all the county offices, and the railroad facilities and connections with all parts of the country are of the best. The city is connected with the city of Lewiston (q.v.), located immediately across the river, by four large iron bridges, and the two cities are so closely related socially and in a business way that they form practically one community and are known as the Twin Cities of Maine. Pop. (1842, at the time of its incorporation as a town) about 2,000; (1869, at the time of its incorporation as a city) 6,169; (1910) 15,064; (1914) 16,000.

AUBURN, N. Y., city and county-seat of Cayuga County, on Owasco River, the outlet of Owasco Lake, and on the New York Central, Lehigh Valley, and Central New York Southern steam railroads, 25 miles southwest of Syracuse. Interurban trolley lines connect with Rochester and Syracuse, and local trolley lines with the beautiful Owasco Lake and picturesque neighborhood. Auburn was first settled in 1793 by Col. John Hardenbergh, and was called Hardenbergh's Corners; in 1805 the name was changed to Auburn, and it was selected as the county-seat; in 1815 it was incorporated as a village and in 1848 became a city. Auburn was the home of the late William H. Seward, and the Seward mansion is one of the city's attractions. The city is situated in the heart of the Empire State lake country. One can leave Auburn every morning during a vacation period and visit a different lake each day, and return to the city before nightfall. Owasco Lake, the nearest and most accessible of the lakes, is a picturesque expanse of water, two miles from the city, 12 miles long. In the vicinity are excellent State roads with ample and up-to-date garage and hotel accommodations. It is a beautiful summering place, where fishing, boating, yachting, bathing, canoeing and sports at the lake are the favorite amusements. There is the Burtis Auditorium seating about 3,000 people for indoor entertainment, and a number of other theatres. There are two country clubs, one city club and numerous fraternal organizations that own their own buildings. Auburn is a shopping centre with modern stores and is an industrial centre with 174 factories, employing 8,110 people. The largest industry is a manufactory of agricultural implements which exports its goods to every part of the world; other industries of almost equal importance are carpet, rug and shoe factories, woolen mills, cordage, twine and rope works; the Diesel oil and steam engines, and auto appliances are made here. The United States census of manufactures for 1914 recorded 123 establishments of factory grade, employing 6,627 persons of whom 5,769 were wage earners, receiving $3,578,000 annually in wages. The capital invested was $23,129,000, and the value of the year's output was $16,686,000; of this $6,896,000 was the value added by manufacture. The city has a progressive Chamber of Commerce, two savings banks, two private banks, two national banks and one trust company. The city contains a number of unusually fine private homes with attractive grounds, including Italian and English gardens; fine public and private buildings; churches of practically all denominations; a municipal and general hospital; courthouse; United States government building; State armory, which is the headquarters of Company M of the National Guard; State prison; two libraries, and a fine Woman's Educational and Industrial Union building, one of the largest and best equipped in the United States; there are 12 up-to-date public schools and one high school; there are four Roman Catholic parish schools. Auburn is also the seat of the Auburn Theological Seminary (Presbyterian), which, with its fine buildings, the Welch Memorial, and Dodge Library, Morgan Hall and Willard Chapel, and the Silliman Club House, forms another interesting feature of the city. The seminary maintains a summer school for laymen as well as the regular student's theological course during the remainder of the year. The city maintains a first-class paid fire department, and the municipality owns and operates its own waterworks. Pop. (1910) 34,668; (1914) 36,500.

AUBURN, Neb., city and county-seat of Nemaha County, situated on the Nemaha River and on the Missouri P. and the Chicago, B. & Q. railroads, 65 miles south of Omaha. It was first settled in 1861, became a borough in 1884 and a city in 1890. It is in a rich agricultural region and has large fruit packing and canning plants and a flour mill. The waterworks and lighting system are owned by the city. Pop. (1910) 2,729.

AUBURN THEOLOGICAL SEMINARY, a Presbyterian institution in Auburn, N. Y.; founded in 1818 by the Synod of Geneva, incorporated in 1820. The course, designed primarily for college graduates, is for three years. At the close of 1915 it had 12 professors and instructors, 64 students, 36,315 volumes in the library, grounds and buildings valued at $300,000; endowment, $790,000; productive funds, $793,770; income, $43,279. Its graduates then numbered 1,778.

AUBUSSON, Pierre d', French crusader and grand master of the Order of Saint John of Jerusalem: b. 1423; d. 1503. As a mere boy he fought against the Turks in Hungary, under Duke Albert of Austria. After campaigning against the Swiss in 1444 he went to Rhodes and became a member of the Order of Saint John, where he distinguished himself in fighting the Saracens. In 1476 he was elected grand master and four years later he defended Rhodes successfully against an attack delivered by the Turks under the personal command of Mohammed II. In 1489 the Pope rewarded him by

making him a cardinal, not only on account of his military feats, but because of his endeavors to organize a powerful league of all the Christian nations against the Turks, for which he was often called "the Shield of the Church." Consult Bounhours, 'Historie de Pierre d'Aubusson' (The Hague 1793), and Streck, 'Pierre d'Aubusson' (Chemnitz 1872).

AUBUSSON, ō'bu'sôn', France, capital of the arrondissement of the same name in the department of Creuse. It is situated on the Creuse River, on the Orleans Railroad, and is especially noted for the carpets manufactured in its factories. Pop. (1911) 7,211.

AUBUSSON TAPESTRY. See TAPESTRIES.

AUCASSIN AND NICOLETTE, one of the earliest and by far the best of the efforts of French creative fancy to imitate the Oriental and Latin tales that had won public favor in translations, belongs probably to the 12th century and illustrates a type of story-telling that grew in favor up to the 15th century, with progressive elimination of the lively verses that are here interspersed in the prose. The story recounts the fresh, though not altogether innocent, love of Aucassin, son of the French Count of Beaucaire, for Nicolette, captive daughter of a king of Carthage. The author who is unknown seems to have had democratic sympathies that distinguish him from his fellow raconteurs and associate him politically with such writers of the 13th century as Rutebœuf and Jean de Meung. The pitiful lot of serfs under landlord oppression stirs him to a palpitating sympathy. On the other hand there is a daintiness in the description of Nicolette as, greatly daring in her girlish love, she makes her way by an improvised cord from her chamber window, through darkness and brambles, to the tower where Aucassin lay prisoner. "She felt that the old woman who was with her slept. She put on a dress of silk cloth that she had, very good. She took sheets and towels and knotted them together and made a cord as long as she could and she tied it to the pillar of the window and on it slid down toward the garden. She held her robe with one hand before and the other behind. And she tore herself on the brambles that were great over the grass and she went along the garden. Her blond hair was in little curls and her eyes were bright and smiling, her face regular, her nose slender and well placed, her lips redder than cherry or rose in summer and teeth small and white. . . . And she had a slender waist that you could clasp in your two hands, and the daisy flowers that she bent with the toes of her feet so that they lay low under the daintiness of her feet were just black beside her feet and her legs, so pure white was that girl." There is no other French prose to rival this for more than two centuries. There is a beautiful translation by A. Lang.

BENJAMIN W. WELLS.

AUCH, ōsh, France, capital of the department of Gers, 55 miles west of Toulouse. It consists of a lower and upper town united in several places by flights of steps. The streets generally are steep and narrow. It is the seat of an archbishop, a prefect, and has a Court of Assizes, and has tribunals of first instance and of commerce, a lycée, training-colleges and a lunatic asylum. The manufactures include agricultural implements, leather, vinegar, plaited sandals, and there is a trade in brandy, wine, cattle, poultry and wool; there are quarries of building-stone in the neighborhood. Pop. about 9,000.

AUCHMUTY, ok-mū-ti or â-mū-ti, SIR **Samuel,** British soldier, son of the Rev. Dr. Samuel Auchmuty: b. New York 1756; d. Ireland, 11 Aug. 1822. He graduated from Kings, now Columbia, College, in New York city, in 1775, after which he entered the British army and fought against the Continentals, notably at White Plains and in the battle of Brooklyn. After the termination of British operations in America, he went to India, in 1783, where he served until 1796. In February, 1807, he was in command of the British forces which stormed the South American city, Montevideo. He was now promoted to the rank of major-general and for the next three years was commander-in-chief of the British forces in Madras, during which period he commanded operations against the Java Settlements. Just before his death he was commander-in-chief of the British army in Ireland.

AUCHTERARDER, ouh'tėr-ăr-dėr, **Perthshire,** Scotland, the village in which originated the popular agitation that lead to the disruption in the Church of Scotland and to the establishment of the Free Church. It was the centre of a thriving textile industry, to which has since been added the manufacture of agricultural implements. Pop. (1911) 3,175. Consult 'The Auchterarder Case' (Edinburgh 1842).

AUCKLAND, George Eden, EARL OF, governor-general of India, son of William Eden, Lord Auckland: b. 25 Aug. 1784; d. 1 Jan. 1849. He was called to the bar in 1809; in 1814 he succeeded his father as Lord Auckland. In 1833 he was appointed president of the Board of Trade and master of the mint, under Earl Grey's administration. These offices he held, with the exception of a few months, during which he was First Lord of the Admiralty, until 1835, when he was appointed governor-general of India, on which occasion he was made a Knight of the Grand Cross of the Bath, being created earl in 1839. In 1841 he returned to England. In 1846 he again became First Lord of the Admiralty, which office he held until his death.

AUCKLAND, William Eden, LORD, English statesman: b. 1744; d. 28 May 1814. He was educated at Eton and Oxford and called to the bar in 1768. Four years later he was appointed Under-Secretary of State and one of the directors of Greenwich Hospital. In 1778 he was nominated, with the Earl of Carlisle and Governor Johnstone, a commissioner to treat with the insurgent American colonists, but this mission was not attended with success. In 1785 he was sent as minister plenipotentiary to the court of France, where he concluded a commercial treaty with that country in the following year. In 1788 he was sent as Ambassador to Spain and on his return, October, 1789, he was created an Irish peer as Baron Auckland, being created a British baron four years later. In 1790 he became Ambassador to Holland. From 1798 to 1801 he was joint Postmaster-General. Among his writings are

'The Principles of Penal Law' (1772); 'Remarks on the Apparent Circumstances of the War' (1795); 'Speech in Support of the Union with Ireland' (1800).

AUCKLAND, New Zealand, a province forming the northern part of North Island, and with an area of 25,746 square miles. Auckland, a city and capital of the province, and formerly capital of New Zealand, is situated on the northeast coast of North Island at the mouth of an arm of Hauraki Gulf, 1,350 miles from Sydney, Australia. It stands upon a cluster of extinct volcanoes. In the city and its suburbs there are evidences of as many as 63 points of eruption, making the narrow ithmus a fruitful field for the study of volcanic formations. It has two excellent harbors, one at Waitemata and one six miles distant at Manukan on the opposite side of the isthmus. The former is one of the finest in New Zealand. There are numerous wharves and two graving docks, one of which, the Calliope dock, opened in 1887, is one of the largest in the south seas, admitting 10,000-ton steamers. Connected by steamer with Australia, South Africa, Great Britain, San Francisco and the Pacific Islands and by rail with the chief towns of the island, the city has a large and increasing trade, valued at about $40,000,000 annually; 361 vessels of 856,317 tons burden entered and 241 of 554,815 tons cleared the port in 1913. The site is fine and there are numerous handsome public buildings, including churches, fine schools, an excellent public library containing the Grey collection of manuscripts, a museum and the Auckland University College. Chief manufacturing interests are ship-building yards, sugar refineries, rope factories, boiler works, etc. Its lumber industry, taking advantage of the wide rivers down which logs can be floated, is a very prosperous one, as is also its trade in Kauri gum. The government is municipal. For the year 1917, the municipal electric plant showed a good increase, selling 1,872,938 units valued at $75,-168, as compared with 1,601,292 units, value $63,795, for 1916. There is a United States consulate here. Pop. (1911) with suburbs, 102,676; (1913) 113,334.

AUCKLAND ISLANDS, a group of islands in the Pacific Ocean, 200 miles to the south of New Zealand, lat. 50′ 31″ S., long. 166′ 19″ E. The largest island is about 30 miles long by 15 broad, and is covered with dense vegetation. They were discovered in 1806, and settled in 1849 by the British. At present they are almost entirely uninhabited, and serve as a station for whaling ships. The New Zealand government maintains a station on the largest island as a haven for shipwrecked sailors.

AUCTION and **AUCTIONEER.** An auction is a public sale of property to the highest bidder. It is not material how the sale is conducted, whether by public outcry or other manner. The essential part is the selection of a purchaser from a number of bidders. Catalogues describing the property are usually printed, the terms of the sale are also usually stated in the catalogue. Auctions are generally conducted by persons licensed for that purpose. Bidders may be employed by the owner of the property, if it be done bona-fide and to prevent a sacrifice of the property under a given price, but where the bidding is fictitious and by combination with the owner to mislead the judgment or inflame the zeal of others, it would be a fraudulent and void sale. Unfair conduct on the part of the purchaser will void the sale. Misdescription of property sold will void the sale if it is material. An auctioneer cannot bid for himself; he cannot deny his principal's title; he cannot sell at private sale; he has ordinarily the power to collect the purchase price of goods sold from the buyer. The auctioneer must use ordinary care and skill in the discharge of his duties, and like other agents he must obey the instructions he receives from the owner of property sent him for sale. An auctioneer, according to the weight of authority, who sells stolen property is liable to the owner, notwithstanding that the goods were sold by him, and the proceeds paid over to the thief without notice of the felony. An auctioneer is also liable for want of care of the goods while in his possession. The auctioneer has a lien upon the goods for the charges of the sale, and for his commission. He is the agent of the seller, and, for the same purposes, of the buyer. Consult Bateman, 'Treatise on the Law of Auctions' (7th ed., London 1895.)

AUCTION BRIDGE. See BRIDGE.

AUCUBA, â'kū-ba, a genus containing three species, of which *A. japonica* is the best known. They belong to the *Cornaceæ* family. The species mentioned is a dicœcious evergreen laurel-like shrub of many varieties, native of China and Japan, largely planted on lawns and in shrubberies. It withstands the dust, smoke and gases of cities remarkably well, but is not hardy in the Northern States. The plants bear purple flowers in summer and are particularly beautiful when bearing their scarlet berries which ripen in early spring. They are easily propagated by seed, or by green wood cuttings, and succeed in half shade where the soil is good, friable, moist, but well-drained.

AUDÆ'US (Syrian Udo), the founder of a religious sect called Audians, which held anthropomorphic views, and was established under the following circumstances: Audius (b. at the end of 3d century; d. 370) was a Mesopotamian, of singular purity and severity of character. He became disgusted with the Syrian clergy, and on expressing his opinion with more firmness than discretion, was excommunicated; when a considerable number of sympathizers gathered around him and constituted themselves into a church. But this sect could not long withstand the persecutions to which it was exposed, and died almost at the same time as its founder, who passed the latter part of his life in exile in Scythia, where he converted many pagans to Christianity by the force of his teachings, and the moral beauty of his ascetic life.

AUDE, ōd, a maritime department in the south of France; area, 2,433 square miles. It is mainly covered by hills belonging to the Pyrenees or the Cevennes, and is traversed by a valley drained by the Aude. The loftier districts are bleak and unproductive; the others tolerably fertile, yielding good crops of grain. Its capital is Carcassonne. Pop. about 311,000.

AUDE, a river of France, which rises in the east Pyrenees, in the department of Pyrénées Orientales, and after a course of

nearly 130 miles, falls into the Mediterranean. It receives several affluents, of which the principal is the Orbieu.

AUDEBERT, ōd-bär', **Jean Baptiste,** French naturalist and engraver: b. Rochefort 1759; d. 1800. The first work was 'Histoire Naturelle des Singes, des Makis, et des Galéopithèques' (1800), in which he shows himself an able draughtsman, engraver and writer. Natural history was greatly benefited by his work, the splendor of which was astonishing. His 'Histoire des Colibris, des Oiseaux-Mouches, des Jacamars, et des Promerops' (1802), is esteemed the most complete work that has appeared in this department. Fifteen copies were struck off with golden letters. He changed the color of his impressions in different ways to increase the splendor of the patterns.

AUDHUMLA, ou-dhoom'-lå, a cow in Scandinavian mythology: she licked away the frosts in the spring, she breathed warmth into the icy abyss and brought forth Buri, father of Borr, who was the father of Odin. Upon her milk subsisted the giant Ymir.

AUDIFFRET-PASQUIER, ō'dē-fra'pąs-kyā', **Edmé Armand Gaston, Duc d',** French statesman: b. Paris 1823; d. 1905. He was president of the National Assembly in 1875. He was president of the Senate 1876–79. He was elected to the French Academy in 1878.

AUDIOMETER, for the measurement of hearing, an instrument devised by Professor Hughes, the English inventor of the microphone. Among its constituent parts are an induction coil, a microphone key and a telephone. The audiometer has been materially modified, and is now principally used for obtaining a balance of induction from two electric coils acting upon a third. A scale is provided to show the extent of the movement. A varying or interrupted current being passed through the two outer coils, the preponderating current will produce the most induction if the central coil is equidistant. It can always be moved to such a point that there will be no inductive effect, one counteracting the other. Thus its position measures the relative induction. A telephone is in circuit with the intermediate coil and is used to determine when its position is such that no current is induced in it.

AUDIPHONE, an invention to assist the hearing of partially deaf persons in whom the auditory nerve is not entirely destroyed. The instrument, made of a thin sheet of ebonite rubber or hard vulcanite, is about the size of a palm leaf fan, with a handle and strings attached to bend it into a curving form, and a small clamp for fixing the string at the handles. The audiphone is pressed by the person using it against his upper front teeth, with the convex side outward; when so placed it communicates the vibrations caused by musical sounds or articulate speech to the teeth and bones of the skull, thence to the organs of hearing. For different sounds it requires to be focused to different degrees of convexity. A simple strip of fine glazed mill-board has been recommended by some experimenters as cheaper and equally serviceable; and birch wood veneer has been used with success for the same purpose. The ear trumpet and modern electric devices have to a great extent supplanted the audiphone.

AUDIT, a term denoting an examination into accounts or dealings with money or property, along with vouchers or other documents connected therewith, especially by proper officers, or persons appointed for the purpose. Also the occasion of receiving the rents from tenants on an estate.

AUDITING. See ACCOUNTING.

AUDITION. See EAR; HEARING.

AUDITOR. Term now commonly applied to expert accountants who examine and state the accounts of government departments, corporations, etc. An auditor is an officer of the government, whose duty it is to examine the accounts of officers who have received and disbursed public moneys by lawful authority. In practice an auditor is an officer of the court, assigned to state the items of debit and credit between the parties in a suit where accounts are in question, and exhibit the balance. They may be appointed either by courts of law or equity. They are appointed at common law in actions of account, and in many of the States in other actions, under statutory regulations. The auditor's report must state a special account, 4 Yeates, Penn. 514, giving items allowed and disallowed, 5 Vt. 70, but it is sufficient if it refer to the account, and it is their duty to report exceptions to their decisions of questions taken before them to the court, and exceptions must be taken before them, 4 Cranch, U. S. 308; 22 Bart. N. Y. 39; unless apparent on the face of the report. The report of the auditor as to facts is final in some of the States, unless impeached for fraud, misconduct or very evident error. When the report is set aside in whole or in part, it may be referred back or may be rectified by the court, or accepted if the party in favor of whom the wrong decision is made remits the item.

Treasury Auditors.— In the United States Treasury Department there are six auditors, one for this department itself while the others audit the accounts of the Army, Interior, Post-office, War and State and other departments. These auditors decide whether accounts against the government are submitted in the proper form, but if differences of opinion arise appeal may be made to the Comptroller of the Treasury.

State Auditors.— Most of the State Constitutions provide for auditors who shall audit the public accounts and perform whatever other duties are prescribed by the statutes. These officers are usually elected, in New Jersey, Tennessee and Virginia the election being by joint ballot of the legislature. In Colorado, Oklahoma and Pennsylvania two successive terms are prohibited. Often the auditor is a member of the State executive boards, such as the board of taxes, etc.

Local Auditors.— In Indiana, Iowa, Minnesota, Ohio and South Dakota the county auditors are elective and in about one-third of the States the county auditors are regular county officers. County auditors also are found regularly in California, Mississippi, Nevada, New Jersey, South Carolina and Washington, and such officials may be found also in the larger counties of Kansas, Michigan, New York, Pennsylvania and Utah. It is the duty

of these auditors to keep accounts of receipts and expenditures, to issue warrants for the expenditures of the county, to prepare tax lists, and sometimes to assess property for purposes of taxation. In some States the county clerks act as accountants and auditors and in several States the county commissioners or board of supervisors audit the accounts. In New England the boards of selectmen usually examine town and township accounts, while in the Middle Atlantic and North Central States this work is performed by the town boards. In Kansas, Minnesota, Nebraska, North Dakota, Ohio, South Dakota, Wyoming, and partially in Massachusetts and New York, a centralized system of auditing county and town accounts has been put into operation. Consult Beard, C. A., 'American Government and Politics' (New York 1911), and 'American City Government' (New York 1912); Fairlie, J. A., 'Local Government in Counties, Towns and Villages' (New York 1906); Hart, A. B., 'Actual Government' (New York 1908); Renick, E. I., 'Control of National Expenditures,' in *Political Science Quarterly*, Vol. VI, pp. 248–81 (1891); Thorpe, F. N., 'Federal and State Constitutions' (Washington 1909). For the law as to auditors in England consult Pixley, 'Auditors: their Duties and Responsibilities' (London 1896).

AUDITORY CANAL. See EAR.

AUDITORY, or EIGHTH, NERVE, the nerve of hearing, and of the sense of position. It has its origin in two distinct portions of the ear, in reality being two distinct nerves, the *cochlear* and the *vestibular*, both of which are sensory in their function. The cochlear nerve originates in the cells of the organ of Corti in the cochlea of the ear, and is the one that carries sound impressions into the brain. The vestibular nerve has its origin in the semicircular canals and is the nerve that conveys the sense of localization of position. Both of these nerves soon join and run together in the internal meatus, where they lie in the same sheath for some distance with the seventh or facial nerve. They enter the medulla, the cochlear nerves forming the acoustic striæ on the floor of the fourth ventricle, and end about the superior olivary body and the nucleus of the trapezium. From here the fibres enter the fillet and end about the auditory centre in the brain in the second temporal convolution. Disease here causes auditory aphasia. The fibres of the vestibular branch end in the nuclei of Deiters and Bechterew in the medulla, and then further fibres pass for the most part into the cerebellum. Disease here causes cerebellar ataxia. See ATAXIA; APHASIA; EAR; EQUILIBRIUM; HEARING.

AUDLEY, Sir James, one of the original knights of the Order of the Garter: b. 1316; d. 1369. He was in the suite of Edward III and the Black Prince in France, and in 1350 distinguished himself in the naval engagement with the Spaniards at Sluys. He was so conspicuously brave at the battle of Poictiers that the Prince retained him as his own knight and conferred on him an annual revenue of 500 marks, which he immediately gave over to his squires. This generosity so pleased the Prince that he immediately conferred a further annuity of 600 marks on Audley. He also accompanied the Black Prince to Spain and in 1369 the office of seneschal of Poitou was conferred on him. He took part in the capture of La Roche sur Yon, in Poitou, in the same year, dying some months later. When Edward III founded the Order of the Garter, in 1344, Audley was one of the first honored.

AUDLEY, a manufacturing town in Staffordshire, England. It has a church dating from the time of Edward II. Pop. 14,776.

AUDLEY OF WALDEN, Thomas, BARON, English Lord Chancellor in the reign of Henry VIII: b. 1488; d. 1544. In 1529 he was speaker of the famous Long Parliament. In 1532 he was knighted and made Keeper of the Great Seal, becoming Lord Chancellor in the following year. In this office he succeeded Sir Thomas More, at whose trial he was presiding judge. He was also presiding judge at the trials of the supposed accomplices of Anne Boleyn, when the King wished to rid himself of that Queen, and of the paramour of Catherine Howard. He figures throughout English history of that period as the accomplice of Henry VIII in all his foulest deeds.

AUDOUARD, ō'dowär', **Olympe,** French writer: b. 1830; d. 1890. She was married to a notary in Marseilles, but soon after divorced. She traveled in Egypt, Turkey and Russia; and having conducted various journals in Paris since 1860, made a successful lecture tour through the United States in 1868–69. After her return she became interested in spiritualism. She was an ardent advocate of woman's rights. Among her novels and books of travel may be mentioned 'How Men Love' (1861); 'The Mysteries of the Seraglio and of the Turkish Harems' (1863); 'The Mysteries of Egypt Unveiled' (1865); 'War to Man' (1865); 'Across America' (1869–71); 'Parisian Silhouettes' (1883).

AUDOUIN, ō'dooaṅ', **Jean Victor,** French naturalist: b. Paris 1797; d. 1841. He was professor of entomology in the Paris Natural History Museum and was the founder and first president of the Entomological Society. He wrote much respecting the injuries done by insects to vine and silk culture. He contributed the part on insects in Cuvier's 'Règol Animal.'

AUDRAN, ō-drāṅ', **Edmond,** French composer: b. Lyons 1842; d. 1891. He studied music in Paris and in 1861 became choral director at Saint Joseph's Church, Marseilles. In 1881 he returned to Paris and collaborated with Chivol and Duru in comic operas. He composed several comic operas which were exceedingly popular, among them 'La Mascotte' (1881); 'Olivette: Le Grand Mogol' (1884); 'Miss Helyett' (1890); 'La Poupée.'

AUDRAN, ō-drāṅ', **Gerard,** French engraver: b. Lyons 1640; d. Paris 1703. He studied under his father and uncle and after three years at Rome under Maratti, where he acquired a high reputation by his engraving of Pope Clement IX, was recalled to France by Colbert, and appointed engraver to Louis XIV. Here he engraved the works of Lebrun, illustrating the battles of Alexander, and many paintings by Raphael, Titian, Domenichino, Poussin and others. He reproduced Mignard's decorations of the ceiling of the royal apartment at Versailles, and the cupola of the

Church of Val de Grace. He wrote 'Les proportions du corps humain' (1683). His nephews, BENOIT (b. 1661, d. 1721) and JEAN (b. 1667, d. 1756), were also engravers.

AUDREY, Saint. See ETHELREDA, SAINT.

AUDREY, â'drĭ, (1) a shepherdess in Shakespeare's comedy 'As You Like It.' (2) A character in Jonson's comedy 'A Tale of a Tub.'

AUDSLEY, George Ashdown, Scottish-American architect: b. Elgin, Scotland, 6 Sept. 1838. He established himself in the United States in 1892, and subsequently became prominent both as an architect and author. In collaboration with his brother, WILLIAM J. A. AUDSLEY, he was author of several works — on illuminating, decorating, Christian symbolism, etc., and, individually, published 'Keramic Art of Japan'; 'Ornamental Art of Japan'; 'The Art of Chromolithography,' etc.

AUDUBON, â'dū-bŏn, John James Fougère, American naturalist: b. Les Cayes, Santo Domingo, now Haiti, 26 April 1785; d. New York, 27 Jan. 1851. His father was an adventurer and his mother a Creole. At an early age he showed an absorbing interest in all living things, especially birds, a fondness which remained with him throughout his life. He was a keen and sympathetic observer, rather than a trained specialist either in science or art. He was educated in France and studied drawing for some time under the great artist, David, but in 1798 he returned to America and took possession of a farm owned by his father on the Perkiomen River, near Philadelphia. Here, in 1808, he married Lucy Bakewell, the daughter of an English neighbor; with her he moved to Kentucky and subsequently to Louisiana, meeting in both places with financial misadventures due to his inadaptability to attend properly to trade, which left him so poor that he was obliged to paint portraits and teach dancing and fencing. From his boyhood, however, in all fortunes, he had spent much time in sketching birds and studying their habits, and in 1826 he found means to take these sketches to England, where he elaborated them into the great series which made him famous and relieved his pecuniary troubles. From 1827–38 he published a series of 1,065 colored figures of American birds in a work, 'The Birds of America,' which still holds its place as one of the most attractive and beautiful ornithologies of the world. No reading matter accompanied these plates, but later in 1831–39 five volumes were issued under the title 'Ornithological Biography,' the technical part of which was by William McGillivray. Many editions and reprints were issued later, of which the most important was the octavo edition of 1844. In 1830 he returned to America to travel for new material and, in 1831, began the publication of his 'Ornithological Biography,' in five volumes. In 1842, after 12 years spent chiefly in explorations, he bought a home on the Hudson River at a spot considerably north of New York city at that time, but now within the city limits and known as Audubon Park; here his two sons, Victor Gifford and John Woodhouse Audubon, also lived with their families. In 1843 the naturalist took another long journey, going to the Missouri River region. After 1844 he devoted himself with Dr. John Bachman (q.v.) and his sons, to a new publication, 'The Quadrupeds of America.' After 1847 his health began to fail and he gradually lost the use of his mind. He was buried in Trinity Cemetery, New York. The full details of his life may be found in 'Audubon and His Journals,' by his granddaughter, Maria R. Audubon, with zoological and other notes by Elliott Coues (1897), and in an earlier biography by Lucy Audubon, as well as in 'The Life and Adventures of J. J. Audubon, the Naturalist,' by Robert Buchanan (1869). His latest biographer is Francis Hobart Herrick, who has compiled a very excellent work, 'Audubon the Naturalist,' from a mass of documents in the possession of an old notary in Couëron, France (2 vols., New York 1917).

AUDUBON SOCIETIES are organizations of bird-lovers who work to educate public opinion to a proper appreciation and protection of bird life. The term "Audubon Society" was coined by George Bird Grinnell (q.v.) in 1886, and an organization for the protection of birds at that time started by him attained a membership of 48,862. It was later discontinued, but the name and plan survived. In 1895 Audubon societies were organized in Massachusetts and Pennsylvania, and during the next few years bird-lovers in many other States followed suit. The national committee of Audubon societies was organized at a meeting held in Washington in 1902; and 1905 saw the organization of the National Association of Audubon Societies for the Protection of Wild Birds and Animals, with William Dutcher as president and T. Gilbert Pearson as secretary and financial agent. The generosity of Mr. Albert Willcox provided financial support of the undertaking at this period (more than $331,072 in 1905 and 1906), and at the end of 1906 the Association had an interest-bearing endowment fund of more than $336,000 and an income from other sources of approximately $9,000. In May 1910, the Audubon bill to prohibit the sale of the feathers of native birds in the State of New York was enacted. A similar law has since that time been enacted in about 12 other States. Many laws for the establishment of game commissions and game warden forces, or prohibiting the sale of game, owe their existence to Audubon society activities; and from the beginning the educational side of Audubon work has been prominent. Up to 1 July 1915 the Association had enrolled as Junior Audubon members 373,153 school children, and had given systematic instruction in bird lore to them and to 18,966 teachers. Hundreds of articles bearing on the economic value of birds to mankind have been published in school journals, in various literary magazines and in newspapers throughout the country. A force of six or seven lecturers is maintained, who give illustrated addresses before audiences of school children and to women's clubs, granges and other organizations. A system of courses in bird study is given by the association's special corps of lecturers at many different State summer schools for teachers.

In 1914 the Association began its department of applied ornithology. This is a special work to encourage the people generally to attract birds about their homes by artificial means, and to induce those favorably situated to engage in the propagation of wild ducks and other game

birds. Bulletins and lectures bearing on this point are destined to produce a decided influence on popular sentiment.

The National Association of Audubon Societies is to-day a strong, far-reaching institution. While engaging actively in preserving wild life, it recognizes fully the claims of the sportsman, and has no fight with the man who legally kills game birds and game animals. In summer it guards, by means of paid wardens, virtually every important colony of sea-birds on the Atlantic and Gulf coasts of the United States, as well as on many lakes of the interior. It owns or leases many islands where ducks and sea-birds breed. It originated the system of Federal bird reservations, and co-operates financially with the government in protecting them. It publishes and distributes annually over 6,000,000 pages of bird-protective literature, and the home office has become a general clearing house for all kinds of information in reference to the study and conservation of wild birds and animals. The Association makes expenditures every year for the protection of big game, for feeding game birds and song birds in winter, and in prosecuting violators of the law. The Association collected over $90,000 for the bird-protective cause in 1914, and the friends of the organization speak with pride of the fact that only 7 per cent of the income is being expended for administrative salaries.

AUE, Hartmann von, German poet: b. 1170; d. about 1215. He was of humble birth, being the vassal of the Lord of Aue, who took him with him in one of the crusades, either in 1189 or 1197. Very little is known of his life. Of his works 'Erec' is undoubtedly the best (2d ed. in High German, Halle 1855). In this epic poem, of some 10,000 lines, the Arthurian legends are first introduced into Germany. Next in importance is his 'Gregorius von Stein,' the material of which is drawn from French romance (Berlin 1838). His most popular work was 'Der arme Heinrich,' his one work which is based on German folk lore (published by the Grimm Brothers, Berlin 1815). Many editions of his works have been published in German. Consult Cassel, 'Die Symbolik des Blutes und der arme Heinrich des Hartmann von Aue' (Berlin 1882).

AUE, Saxony, Germany, city in Zwickau, on the Zwickau-Schwarzenberg Railroad, near the juncture of the Mulde and the Schwarzwasser rivers. It is a busy industrial centre, manufacturing paints, metal ware goods, textiles, furniture, paper, tobacco pipes, etc. It is the seat of the District Court, has five public buildings and its population is about 20,000.

AUENBRUGGER VON AUENBRUG, ow'ĕn-brŭg'ĕr fŏn ow'ĕn-brŭg, **Leopold,** Austrian physician: b. Gratz 1722; d. Vienna 1809. As early as 1754 he had discovered the method of studying internal diseases (percussion) which made him famous; but not until after seven years of experiments and verification did he publish his treatise, entitled 'Inventum Novum ex Percussione Thoracis Humani Interni Pectoris Morbos Detegendi' (1761). The book marks an epoch in the modern history of medicine, but attracted scant attention until it was translated and illustrated by Corvisart in 1808. He also published two treatises on insanity.

AUER, Aloïs, Ritter von Welsbach, Austrian printer: b. Wels 1813; d. 1869. He was trained as a compositor and in his leisure moments acquired several languages, becoming a professor of Italian in the Gymnasium of Linz. In 1839 he set out on a tour of Germany, Switzerland, France and England, collecting material for his art. From 1841 to 1868 he was at the head of the imperial printing office at Vienna. He made many typographical discoveries and published 'Die Sprachenhalle oder das Vaterunser in 608 Sprachen' (1844); and 'Das Vaterunser in 206 Sprachen' (1847); 'Die Buchschriften des Mittelalters' (1852); 'Geschichte der K.-K. Hof-und Stadtsdruckerei in Wien' (1851).

AUER, Leopold, Hungarian violinist: b. Veszprim, Hungary, 28 May 1845. His first musical training was gained in Pesth; in 1858 he studied in the Vienna Conservatory and later was a pupil of Joachim in Hanover. In 1863 he was concert master in Düsseldorf. In 1868 he was appointed soloist of the imperial orchestra in St. Petersburg, where he was professor in the conservatory. By this time he was becoming known as one of the world's greatest violin soloists. In 1895 he was raised to the rank of a hereditary noble. He is also famous as a teacher, among his pupils being Elman and Zimbalist.

AUERBACH, ow'ĕr-baH, **Berthold,** German novelist: b. Nordstetten, Würtemberg, 28 Feb. 1812; d. Cannes, France, 8 Feb. 1882. He began to write while a student in Heidelberg and under the pseudonym "Theobald Chauber" produced a 'Biography of Frederick the Great' (1834–36). He was the founder of the modern German "tendency novel," in which fiction is used to influence public opinion on social, political and religious questions. Auerbach was an admirer of Spinoza, and the latter's philosophy is evident in his novels. A series of novels from the history of Judaism, under the collective title 'The Ghetto,' of which 'Spinoza' (1837) and 'Poet and Merchant' (1839) were printed in separate editions, was followed by a translation of Spinoza, with a critical biography (1841). 'Black Forest Village Stories' (1843), was received with universal favor, translated into nearly all European languages and established his fame. To this class of tales belong also 'The Professor's Lady' (1847); 'Little Barefoot' (1856); 'Joseph in the Snow' (1860); 'Edelweiss' (1861); 'After Thirty Years' (1876). His first effort in the field of the novel, 'New Life' (1851), met with little favor; but 'On the Heights' (1865) constituted the crowning success of his literary career. It was followed by 'The Villa on the Rhine' (1868); 'Waldfried, a Family History' (1874); and 'The Head Forester' (1879). His last years were embittered by the growth of anti-Semitism in Germany. His 'On the Heights' is still popular. His works appeared in 18 volumes in 1892–95. See Auf der Höhe. Consult Bettelheim, A., 'B. Auerbach, der Mann, sein Werk' (1907); Lasker, E., 'Berthold Auerbach, ein Gedenkblatt' (1882), and Zabel, 'Berthold Auerbach' (Berlin 1882).

AUERBACH, Henry: b. 1482, at a place of the same name in Bavaria, the builder of the Auerbach court and cellar at Leipzig, mentioned in Goethe's 'Faust.' The building was

erected in 1530, and tradition reports that five years after Dr. Faust was seen riding out of it on a barrel of wine. This tale Goethe has made use of in his famous poem.

AUERLITE, a rare North Carolina mineral, remarkably rich in thoria, named after Dr. Carl Auer von Welsbach, the inventor of the Welsbach incandescent gas mantel. It was originally described as a hydrous silico-phosphate of thorium, $ThO_2.(SiO_2.\frac{1}{2}P_2O_5)+2H_2O$. It occurs in yellowish, zircon-like crystals of resinous lustre and having a hardness of 2.5 to 3 and a specific gravity to 4.1 to 4.7.

AUERSPERG, Adolf Wilhelm Daniel, PRINCE, brother of Prince Karlos Auersperg, Austrian statesman: b. 21 July 1821; d. 5 Jan. 1885. From 1841 until 1860 he served in the army, attaining the rank of major of dragoons, in the regiment of Prince Eugene. In 1867 he began his political career as a member of the Bohemian Diet, where he represented the landed proprietors in the Liberal party. In the following year he became a life member of the upper chamber of the Austrian Reichsrath. In 1870 he became governor of Salzburg, and was head of the Austrian ministry in the year following. With the authority that this office gave him he was very active in effecting electoral reforms, especially in the matter of securing direct representation in the lower chamber of the Reichsrath. He was also instrumental in bringing about closer relations with Hungary.

AUERSPERG, ow'ĕr-spĕrH, **Anton Alexander,** COUNT OF, Austrian poet and statesman, wrote under the name Anastasius Grün: b. Laibach, Carnolia, 11 April 1806; d. Gras, 12 Sept. 1876. Studied engineering in Graz, but later took up philosophy and law in the University of Vienna. In 1848 he was elected to the German preliminary Parliament, and later became a member of the National Assembly in Frankfurt. In 1861, under the ministry of Schmerling, he was created a life member of the Austrian upper house, where he became prominent as a Liberal. Already as a youth his poetry had been attracting attention, his first works being of a political nature. His best known, non-political poem was 'Der letzte Ritter' (1830), written in the metre of the "Nibelungenlied," and eulogizing Maximilian I. Among his other noteworthy works are 'Die Niebelungen im Frack' (1843); 'Der Pfaff vom Kahlenberg' (1850); 'Volkslieder aus Krain' (1850); 'Robin Hood' (1864). His collected works were edited by L. A. Frankl (5 vols., Berlin 1877).

AUERSTADT, ow'ĕr-stĕt, Saxony, a village famous for the great battle which took place there 14 Oct. 1806, between the French under Davoust, and the Prussian army under Duke Charles of Brunswick, which ended in a great victory for the former. The Prussians, who numbered 48,000, left nearly half of their men dead or wounded on the ground, while the French (30,000) escaped with a loss of only 7,000. Napoleon made Davoust Duke of Auerstadt. The village lies 25 miles northeast of Weimar. Consult Lettow-Vorbeck, 'Der Krieg von 1806 und 1807' (Vol. I, Jena und Auerstädt, Berlin 1891).

AUF DER HÖHE, 'On the Heights' (1865) reflects a period of constitutional political conflict in Germany, and is the most widely known of Auerbach's novels. The central figure is a king whose self-confident individuality comes in conflict with his love of popular freedom. Anticipating the "superman" of later writers, he feels that his nature is cast in too large a mold to be confined by constitutional restraints or ethical conventions. In conflict with a majority of the elected representatives of the people over some ecclesiastical question, he dissolves the assembly in his impatience of any outer control. The same characteristics are manifesting themselves meantime in his domestic life. His queen is a gentle lady of domestic instincts. He loves her, yet finds in the forceful, energetic Countess Irma, one of her ladies in waiting, a spirit so answering to his own that they join to transgress, he the bond of marriage, she of loyalty to her queen. Atonement comes first to Irma, who withdraws from the court into solitude, recognizing that one who would live a life of nature may not claim the protection of the social order. Thus the king is brought to realize that life for its full unfolding depends not only on following the law of nature or the law of custom, but in the co-ordination of them, when man of his own free will yields obedience to law. He dismisses his autocratic counsellors and bows to the will of his people. The stress of this psychic drama is relieved by scenes between the queen and Wallpurga, the little prince's peasant nurse, who passes, as does her husband, through a conflict parallel to that of Irma and the king, though both are saved from straying by their unsophistocated respect for the folk-ways. The contrast between court and peasant life is a primary interest in 'On the Heights.' There are translations by S. A. Stern and others.

BENJAMIN W. WELLS.

AUFFENBERG, ouf'-ĕn-bĕrH, **Joseph,** BARON VON, German dramatist: b. Freiburg, 25 Aug. 1798; d. there, 25 Dec. 1857. After studying law in the Freiburg University, he entered the army, where he attained the rank of lieutenant of the horse guards. Several years afterward he became president of the committee of the Court Theatre at Karlsruhe. Among his more important productions are 'Pizzaro' (1823); 'Ludwig XI in Peronne'; 'Die Filibustier'; 'Kohich Erich'; 'Das Opfer des Themistokles'; 'Fergus MacIvor'; 'Das Nordlicht von Kasan.' His collected works were published at Wiesbaden in 1855 in 22 volumes. Consult Stahl, 'Joseph von Auffenberg' (Hamburg and Leipzig 1910).

AUFRECHT, ouf'rĕHt, **Theodor,** German Oriental scholar: b. Leschnitz, 7 Jan. 1822; d. 1907. Graduating from the University of Berlin, he immediately became interested in Oriental research. When only 25 years of age he published a treatise on Sanskrit (Bonn 1847). With Kirchhoff he collaborated in the publication of 'Die umbrischen Denkmäler' (1849–51). In 1862 he was appointed professor of Sanskrit at the University of Edinburgh, but in 1875 returned to Bonn. Among his works are an edition of the 'Rigsveda,' rendered into Roman letters (Bonn 1877); 'Aitareya Brahmana' (1879); 'Catalogus Catalogorum,' an alphabetical register of Sanskrit works and authors (Leipzig 1896–1903).

AUGEAN (â'jē-an) **CODEX** (*Codex Augiensis*), a noted Greek and Latin manuscript of the Epistles of Saint Paul, supposed to have been written in the 9th century, and so called from *Augia Major*, the name of a monastery at Rheinau. After passing through several hands it came, in 1718, to Dr. Bentley, who purchased it for 250 Dutch florins. It is now in the library of Trinity College, Cambridge. This manuscript is written in uncial letters, and without accents; not *continua serie*, as is common with the more ancient copies, but with intervals between the words, and a dot at the end of each. The Greek text is written in capitals, the Latin in Anglo-Saxon letters; hence it is tolerably clear that it must have been written in the west of Europe, where that formation of the Latin letters, usually called *Anglo-Saxon*, was in general use between the 7th and 12th centuries.

AUGEAS, in Greek legend, a king of Elis, famed for his stable, which contained 3,000 oxen and had not been cleaned for 30 years. Hercules was desired to clear the filth away in one day, and Augeas promised if he performed it to give him a tenth part of the cattle. This task Hercules is said to have executed by turning the river Alpheus, or as some say, the Peneus, through the stable, which immediately carried away the dung and filth. Augeas refused to perform his engagement. Upon this a war ensued and Hercules conquered Elis and put Augeas to death.

AUGER-SHELL, a common designation of the spiral gastropod mollusks of the *Tereboidæ* family. The shells are slender and tapering, sometimes ending in a sharp point and are usually decorated with brown, orange and red spots or patches. More than 200 species are known, all inhabitants of tropical waters, where they occur from the shallow waters of the shore to very great depths.

AUGEREAU, ōzh-rō', **Pierre François Charles**, Duke of Castiglione, a marshal of France: b. Paris, 1757; d. 12 June 1816. He came of humble parentage, served for some time in the French carabineers and later joined the Neapolitan army. He remained in the latter service until 1787, when he became a fencing master at Naples. In 1792 he, with all other French residents, was banished from Naples and at once joined the French Revolutionary army. He distinguished himself in 1794 as general of brigade in the army of the Pyrenees, and in 1796 as general of division in the army of Italy. He made himself master, 16 April, of the intrenched camp of the Piedmontese at Ceva, afterward of that at Casale; threw himself on the bridge of Lodi, and carried it with the enemy's intrenchments. 1 August he came to the assistance of Masséna; maintained during a whole day a most obstinate struggle against a superior number of troops and took the village of Castiglione, from which he derived his ducal title. In the battle of Arcole, when the French columns wavered, Augereau seized a standard, rushed upon the enemy and gained the victory. The directory bestowed this standard on him 29 Jan. 1797. In 1799 he was chosen a member of the Council of Five Hundred, and therefore resigned his command. He then obtained from the consul Bonaparte the command of the army in Holland. Being superseded in October 1801, he remained without employment till 1803, when he was appointed to lead the army collected at Bayonne against Portugal. When this enterprise failed he went back to Paris, and 19 May 1804 was named marshal of the empire, and grand officer of the Legion of Honor. In July of this year the King of Spain sent him the order of Charles III. He contributed to the successes which gave birth to the peace of Pressburg, and in March 1806, had possession of Wetzlar and the country around, until, in the autumn of this year, a new war called him to Prussia. Early in 1811 Napoleon gave him the command of a corps in the army of Spain. After the entrance of the allies into France, he made submission to Louis XVIII, who made him a peer. Napeoleon, on his landing in 1815, declared him a traitor. Augereau expressed himself in his favor, but took no active part in the new order. After the King's return he took his place again in the chamber of peers.

AUGIER, ō-zhyā', **Guillaume Victor Emile**, French dramatist: b. Valence, 17 Sept. 1820; d. Croissy, 25 Oct. 1889. He was well educated and prepared for the bar. He was the grandson of Pigault Lebrun, and from him inherited a bent for literature. In 1844 he wrote a two-act play in verse, 'La Ciguë,' which enjoyed considerable success at the Odéon. Thereafter his career was decided and at regular intervals for many years, alone or in collaboration with others—Sandeau, Labiche, Foussier—plays were produced which raised the drama to a realistic life and to a truer morality than it had known since Molière. 'L'Aventurière' (1868) was the first of his important works and in it there is apparent a deviation from the romantic models of the earlier years of the century. 'Gabrielle' (1849) champions the average conventional. 'Diane' (1852) and 'La pierre de touche' (1853) show a tendency to get away from the sensationalism of the romanticists. 'Le fils de Giboyer' (1862) was regarded as an attack on the Clerical party and was only brought out by the direct intervention of the Emperor. With Sandeau he produced 'Le gendre de M. Poirier' (1854), thought by many the greatest French drama of the 19th century. 'Ceinture dorée' (1855) was a satire on the conventional marriage and was the forerunner of a series of social satires of which 'Les effrontés' (1861) was perhaps the most noteworthy. 'Le mariage d'Olympe' (1855) shows the courtesan as she is and without the glamour with which she was surrounded by the romanticists. In 'Les lionnes pauvres' (1858) appears Augier's greatest female character, Séraphine. 'Maitre Guérin' (1864) presents a fine study of the tricky country lawyer. In 1873 appeared 'Jean de Thommeray.' While patriotic it is a trifle prosaic and its success was mediocre. 'Madame Caverlet' (1876) deals with divorce and 'Les Fourchambault' (1879) is also a problem play. Augier was not a mere preacher, but a moralist, with a sane outlook on life. His dramas are not dependent merely on plot for their interest, but rather in the delineation and evolution of the characters introduced. See LE GENDRE DE M. POIRIER; LE FILS DE GIBOYER. Consult Doumic, 'Portraits d' écrivains' (Paris 1894); Gaillard, 'Emile Augier et la comédie sociale' (Paris 1910); La-

cour, 'Trois théâtres' (ib. 1880); Matthews, 'French Dramatists' (New York 1881); Parigot, 'Emile Augier' (Paris 1890); Wells, 'Modern French Literature' (Boston 1899).

AUGITE. See PYROXENE.

AUGSBURG, owgz'burg, Bavaria, city and capital of the government districts of Suabia and Neuberg, 35 miles northwest of Munich. It is situated on a point of land formed by the junction of the Lech and the Wertach. The town has a mediæval appearance, there being very many buildings extant of the period from the 15th to the 17th centuries. It contains several churches, rich in architectural beauty and in artistic associations. These churches are rich in metalwork, stained glass windows, etc., the cathedral containing several altar pieces by Holbein the Elder. The Rathaus is notable for its Golden Hall. Other noteworthy buildings are the former palace of the prince-bishops, the royal picture gallery, the city library, etc. Augsburg has large cotton and woolen mills, machine shops, and manufactures acetylene gas, chemicals, paper, jewelry and leather. The city was founded by Augustus in 12 B.C. The Huns devastated it in the 5th century, Charlemagne in the 8th and Welf in the 11th. In 1276 it received its freedom and at the time of the Reformation was one of the most flourishing cities of Europe. Its trade at this time was very great and a great number of merchant princes were numbered among its citizens. It also became distinguished as an art centre, and was represented in this field by the Holbeins, Altdorfer and Burgkmair. Several Diets were held here and it was prominent in the Reformation. Much of its prosperity was destroyed during the Thirty Years' War. It lost its freedom with the fall of the German empire in 1806, and was joined to Bavaria. Pop. (1910) 102,487. Consult 'Die Chroniken der schwäbischen Städte, Augsburg' (Leipzig 1896); Lewis "Roman Antiquities of Augsburg and Ratisbon" (in *Archæological Journal,* Vol. XLVIII, London 1891); Werner, 'Geschichte der Stadt Augsburg' (Augsburg 1900).

AUGSBURG, League of, a league concluded at Augsburg, 9 July 1686, for the maintenance of the treaties of Münster and Nimeguen, and the truce of Ratisbon, and to resist the encroachments of France. The contracting parties were the Emperor Leopold I, the Kings of Spain and Sweden, the Electors of Saxony and Bavaria, and the circles of Suabia, Franconia, upper Saxony and Bavaria.

AUGSBURG CONFESSION, a document adopted by the Protestants in 1530 as a declaration of faith. Charles V, on his accession to the throne of Germany (1520), found his new dominion the theatre of religious dissensions. The insurrection in Castile, and the war with France and Italy, called Charles into Spain, diverting his attention from the Lutheran schism. The Diet of Spires (1529) had issued a decree for the purpose of conciliating the Lutherans to the proposed Roman Catholic reform, and uniting them against the Sacramentarians and Anabaptists. At this juncture, Charles returned, and the German princes and estates were summoned to convene in Diet at Augsburg in June. The summons was conciliatory, and called for aid against the Turks, making no reference to the religious difficulties of the kingdom, further than to promise at no distinct time a speedy adjustment of them. On the 25th of the month, a confession, prepared by Melanchthon, and approved by Luther, was presented and read by Dr. Christian Bayer in the Diet. This confession is said to have been prepared on the basis of the Swabach and Torgau articles, although these had been drawn up (1528–29) in the attempt to unite with the Zwinglians, and the object of the present confession was to become reconciled to the Roman Catholic reform party. A copy of the confession, in German and Latin, was delivered to Charles. Two days after the reading of the confession, it was delivered to the Roman Catholic theologians for a reply. The reply was read in the Diet on 3 August following, and called forth from Melanchthon a defense (*Apologia Confessionis*), which was afterward enlarged and published in Latin, and then in German. The object of the Augsburg Confession was not attained, and the edict of the Emperor (22 September) gave the Lutherans until the following April to bring themselves into conformity with the requirements of the Church, and required their co-operation with the throne against the Zwinglians and Anabaptists. The Augsburg confession and Melanchthon's defense were generally circulated in western Europe, and became a sort of rallying point among the reformers. Consult Jacobs, 'The Book of Concord' (Philadelphia 1882)and Schaff 'Creeds of Christendom' (New York 1884).

AUGSBURG SEMINARY, an educational institution in Minneapolis, Minn., under the auspices of the Lutheran Church. It was organized in 1869 and reported in 1915: Professors, 9; students, 154; grounds and buildings valued at $120,000; income, $19,000; graduates, 393 from theological department; 247 from college.

AUGUR, Christopher Colon, American military officer: b. New York, 10 July 1821; d. Washington, 16 Jan. 1898. He was graduated at the United States Military Academy in 1843; became major of the 13th United States Infantry in 1861; colonel of the 12th Infantry in 1866; brigadier-general, United States army, 4 March 1869; major-general in the volunteer service in 1862; mustered out of that service in 1866; and was retired in the regular army, 16 July 1885. He commanded a division in the battle of Cedar Mountain, being severely wounded. Consult Augur, E. P., 'The Augur Family' (Middletown 1904).

AUGUR, Hezekiah, American sculptor: b. New Haven, Conn., 21 Feb. 1791; d. 10 Jan. 1858. He was the son of a carpenter and early developed a talent for wood carving. He became successively a cobbler, grocery clerk and merchant. 'Jephthah and His Daughter,' in the Trumbull gallery at Yale, is the most important of his works. In addition to his skill as a sculptor, he possessed much mechanical genius, inventing among other machines one for carving wood.

AUGURIES AND AUSPICES, the replies of the augurs, a celebrated college of diviners in ancient Rome. Their function was to determine, reveal and interpret the will of the gods towards men in regard to some

definite matter or course of action already determined or in progress. This they determined from the occurrence of certain signs, connected with thunder and lightning; the flight and cries of birds; the feeding of the sacred chickens; the action of certain quadrupeds or serpents; accidents, such as spilling the salt, stumbling of a horse, etc. The answers of the augurs and the signs were called auguries; bird-predictions were called auspices. Nothing was undertaken without the advice of the augurs, and by the words "alio die" ("meet on another day"), they could dissolve the assembly of the people and annul decrees passed at the meeting. Taking the auspices in regard to state action gradually degenerated into a mere religious fiction, used by the ruling powers to promote or thwart action, according to their desires. Consult Bouché-Leclerq, 'Histoire de la divination dans l'antiquité' (Paris 1881–82); and articles "Augures" and "Auspicium" in Pauly-Waissow, 'Realencyklopädie der klassischen Altertumswissenschaft' (Stuttgart 1896).

AUGURS. See AUGURIES AND AUSPICES.

AUGUST, ou'güst, the name of many princes of the German principalities: (1) AUGUST WILHELM, Prince of Prussia, brother of Frederick the Great and general in the Prussian army: b. Berlin, 9 Aug. 1722; d. 12 June 1758. He took an active part in the Silesian campaign, and distinguished himself at the battle of Hohenfriedberg (in June 1745), but owing to the fatal retreat of Zittau, in 1756, he incurred the displeasure of his brother, and withdrew from the army. This conflict between the two brothers led to a correspondence, which was published in 1769. (2) AUGUST EMIL LEOPOLD, Duke of Saxe-Gotha and Altenburg, successor to the throne, 20 April 1804. He was twice married, and the first marriage left him issue, one daughter, who became the reigning Duchess of Saxe-Coburg, and died in 1822. By the second marriage he had no children, and on his death he was succeeded on the throne by his brother, Frederick IV, with whose decease, 11 Feb. 1825, the line of Saxe-Gotha became extinct. Duke August Emil Leopold was a favorite of Napoleon, and his duchy enjoyed perfect immunity from the burdens of French invasions and French wars. He was a man of taste and considerable literary talent. (3) AUGUST FRIEDRICH WILHELM HEINRICH, Prince of Prussia: b. 19 Sept. 1790; d. 19 July 1843, in Bromberg; the son of Prince August Ferdinand, the brother of Frederick the Great, who died in 1813. He was considered one of the richest men in Prussia, and left various children by morganatic marriages. He took an active part in the campaign against Napoleon in 1806, by whom he was taken prisoner, and detained in Paris until after the Peace of Tilsit. On his return to Prussia in 1813, he resumed his duties in the Prussian army, fought at Dresden, Ulm and Leipzig, distinguished himself during the campaign of 1814, on various occasions, and bore throughout his life the character of a gallant soldier and an upright man. (4) AUGUST PAUL FRIEDRICH. Grand Duke of Oldenburg: b. 1783; d. 27 Feb. 1853; mounted the throne 21 May 1829, under the title of grand duke, which had been conferred upon his family by the Congress of Vienna; but of which his father had never availed himself. When Oldenburg was invaded by the French, in 1811, he accompanied his father to Russia, where his younger brother (b. 1784, d. 1812) was married to the Grand Duchess Catharine. He distinguished himself in the Russian War, and in 1813 was appointed governor of Revel. His reign, after his return to Oldenburg, was marked by political and material progress. In 1830 he concluded a treaty with Prussia for the annexation of Birkenfeld to the Prussian-Hessian Zollverein, and a reciprocal treaty of navigation. In 1836 he prevailed upon Hanover and Brunswick to make satisfactory arrangements for the regulation of excise duties. In 1831 he laid the foundation for a constitution of Oldenburg, which was ratified in 1848, and which, although modified in 1852, still secures much civil and religious freedom to the people. In 1817 he married the Princess Adelaide of Anhalt-Bernburg, who died in 1820, leaving him two daughters, Frederica and Amalie; the latter, in 1830, married King Otho of Greece. In 1825 he married the sister of his first wife, Ida, who died in 1828, having borne him a son. In 1831 he married, for the third time, Cecilia, youngest daughter of the former King of Sweden, Gustavus Adolphus IV, who died in 1844, leaving a son. He was succeeded by his first son, Nicholas Frederick Peter, Grand Duke of Oldenburg.

AUGUST, the eighth month of our year, named by the Roman Emperor Augustus after himself, being associated with several of his victories and other fortunate events. Before this it was called Sextilis or the sixth month (counting from March). July had been named for Julius Cæsar, and the Senate, to gratify Augustus, decreed that August should have equal length, taking a day from February.

AUGUSTA, ou'güs-te, a title first given to his wife Livia, after the death of Augustus, according to the will of the Emperor. It was afterward conferred by Claudius on Agrippina (51 A.D.), and by Nero on his wife, Poppæa, as well as her daughter (64 A.D.). Eventually it became a common title of the mother, wife, sister or daughter of an emperor.

AUGUSTA, Marie Luise Katharina, a Queen of Prussia, and Empress of Germany: b. 1811; d. 1890. She was the daughter of Charles Frederick, Grand Duke of Saxe-Weimar, and was educated at the Weimar court where she made the acquaintance of Goethe. In 1829 she married William, then Crown Prince of Prussia, afterward Emperor of Germany.

AUGUSTA VICTORIA, German Empress, Queen of Prussia, eldest daughter of Frederick, Duke of Schleswig-Holstein-Sonderburg-Augustenburg and of Princess Adelheid of Hohenlohe-Langenburg: b. castle of Dolzig, 28 Oct. 1858. On 27 Feb. 1881 she married Prince William of Prussia, now William II of Germany. She is the author of one book, 'Erinnerungsblätter an die Palästinafahrt' (1898), which is an account of her observations during a journey through Palestine in 1898. Consult E. Evers' 'Auguste Viktoria' (3d ed., 1897).

AUGUSTA, Ga., the third city of the State in population and wealth. It is the capital of Richmond County, and at the head of naviga-

tion on the Savannah River, 231 miles by water above its mouth. It is 132 miles by rail from Savannah, 171 miles east of Atlanta and 137 miles northwest of Charleston. There is an electric line to Aiken, which eventually is to be extended to Columbia. Two foot bridges and two railroad bridges span the river, which is about 300 yards wide. It lies about 150 feet above sea-level, has an even temperature and dry, invigorating atmosphere very different from most riverside cities, being indeed a well-known health resort for pulmonary invalids, particularly its suburb Summerville, on the Sand Hills 400 feet above it. It is laid out in broad rectangular streets, many of them beautifully shaded, and with a good electric car service; and has several parks, of which the chief are May Park of about 11 acres and Allen Park of 19 acres. The courthouse is in a park containing a granite monument to the Georgia signers of the Declaration of Independence; while on Broad street, the principal thoroughfare of the city, is a noble monument to the Confederate dead with marble statues of Generals Lee, Jackson, Walker and Cobb, and crowned with one of a private soldier, heroic size. The cemetery and fair grounds are also suburban attractions.

Manufactures.— The power is chiefly derived from a dam across the river seven miles above the city (enlarged from a smaller one in 1875, at a cost of about $1,000,000), 150 feet wide at top, 106 at bottom and 11 feet deep; turning a part of the river into a canal affording 14,000 horse-power, sold to industries at $5.50 per horse-power per annum, with a working day of 16 hours. Also 31,000 additional horse-power is derived from an electric power plant recently completed costing $2,250,000. To protect the city from overflows from the river a levee was built in 1915, upon which about $3,000,000 was expended. A barge line has been established for the carriage of freight by the river, thus giving an all-water route to and from Eastern markets, together with the lowest freight rate. Augusta is one of the chief seats of cotton manufacture in the South. Eli Whitney's cotton gin was invented on a farm on the outskirts, and the first working gin was set up in the city. There are 13 cotton mills with offices in the city, having a capital of nearly $6,000,000, operating 329,740 spindles, and 19,360 looms and employing some 8,000 hands. Of over $10,000,000 capital invested in Georgia cotton manufacturing, fully a third is in Augusta. There are also six large cotton seed oil mills and a bleachery. Of other manufactures, the chief are of lumber and wood products, bricks and tile drain pipe from the fine clays in the vicinity, flour, and iron goods. There are 371 manufacturing establishments, with $11,066,000 capital and 5,073 employees, paying $2,153,000 for wages and $6,602,000 for materials, and having a total output valued at $10,456,000. The increase within the past few years, however, has been very large; and it is proposed to utilize the river still more for electric power, the present manufactories practically exhausting the direct water power. The river at Augusta is from five to seven feet deep the year round, and fair-sized passenger and freight steamers make semi-weekly trips to Savannah. Augusta is the largest inland cotton market in the South; and it has also a large shipping trade in lumber, fruit and vegetables. Its annual trade exceeds $80,000,000, its cotton receipts amounting to 550,000 bales. The water supply is derived from the Savannah River and is unlimited. The city abounds in educational and charitable institutions. Most notable among the former is the Georgia Medical College, a branch of the State University at Athens; there are also Richmond Academy, which has recently been put under the care of the State University, Saint Mary's and Sacred Heart (Roman Catholic) academies, Paine's Institute for Colored Students, and high schools for white and colored youth. There are two public libraries, an orphan asylum, two public hospitals (white and colored), a juvenile reformatory, and the Louise King Home. A United States arsenal, a Masonic temple, an Odd Fellows' hall, a Chamber of Commerce and a cotton exchange are also prominent buildings. The city has three daily and several weekly newspapers. The assessed property valuation exceeds $26,000,000, and the bonded debt is about $2,000,000. There are two national and several State banks of which the total capital surplus and undivided profits aggregate about $5,000,000; total deposits about $10,000,000. Augusta is on the line of many railroads, among them the Central of Georgia, the Charleston & West Carolina, the South Carolina & Georgia, the Southern, etc. Its original charter was obtained in 1798, and revised 1882; the mayor is elected for three years, and a city council, consisting of 18 members, is also elected for three years, one-third being elected each year. The board of education is elected by the people. All other offices are appointive by the council, save that the mayor appoints the superintendent of canal and waterworks, and of streets and drains

Population (1910) 37,826. It suffers in the census from having suburbs, North Augusta, across the river in South Carolina; Summerville, and others not counted in; and claims about 60,000 at present.

History.—Augusta was founded in 1736 by Gen. James Edward Oglethorpe (q.v.), the founder of Georgia, and named after the Princess Augusta of Saxony, who married Frederick, Prince of Wales, in that year, and became the mother of George III. All through its early period it was the chief trading station in Georgia, and a very important military post; especially notable as the seat of conferences and treaties with the Southern Indians, who under the treaties of 1763 and 1773 ceded large tracts of land to the whites; the latter, however, had to occupy much of it at the same risk of Indian warfare as before. In 1778 it was made the State capital, and remained such till 1798. The building of the Georgia Railroad in the middle of the 19th century was a heavy blow to its prosperity for a time, carrying trade over new routes; but its natural advantages enabled it to recover itself.

The Southern Confederacy's powder works were located at Augusta, and their tall chimney still stands to mark the site.

AUGUSTA, Maine, city, county-seat of Kennebec County and capital of the State, on the Kennebec River, 40 miles above its mouth, at the head of tidal navigation, and on the Maine Central Railroad, 63 miles northeast of

Portland. It is situated on both sides of the Kennebec, mainly on the right or west bank, and some portion of it, including much of the residential section, occupies an elevation considerably above the river, along which the principal business part of the city extends. The Augusta, Winthrop & Gardiner Electric Railway connects the city with neighboring places, and its water communications afford excellent facilities for travel and trade. The State Capitol is a handsome granite building, for which the stone was quarried from the surrounding hills. It stands on high ground overlooking a wide extent of pleasant country. Among other noteworthy buildings are those of the Maine Insane Hospital, the City Hospital, the public library, the county buildings and the United States arsenal. The churches include those of the Congregationalists, Episcopalians, Free Baptists, Colonist Baptists, Christians, Universalists, Unitarians, Methodists, Roman Catholics and the People's Church. The public schools include all grades from the primary to the high school. In the capitol are the State library, a notable collection of portraits of American statesmen, and in the rotunda, an impressive array of the Civil War battle flags of Maine soldiers. In the principal park is a soldiers and sailors' monument. Augusta, by reason of its railroad and river facilities, is the trade centre of a large region, and the water-power furnished by the Kennebec, across which, just above the city, extends a dam nearly 1,000 feet in length affords abundant means for manufacturing. The cotton factories here employ about 1,100 persons; shoe manufactory, 300; pulp mill, 250; lumber mill, 100; sash and blind factory, 75; and besides various smaller establishments the city has publishing houses in which some 400 persons are employed. The United States census of manufactures for 1914 reported 39 establishments of factory grade, employing 2,379 persons, of whom 2,231 were wage earners, receiving $1,071,000 annually in wages. The aggregate capital invested was $5,069,000, and the year's output was valued at $4,918,000: of this, $1,938,000 was the value added by manufacture. There are two national banks in the city, with a combined capital of $350,000, a trust company having a capital of $100,000, and two savings banks. The deposits of these institutions aggregate $11,000,000. The city is governed by a mayor and a city council, a body consisting of boards of aldermen and common council, elected by the people. Augusta was first permanently settled in 1754 by colonists from Massachusetts; was incorporated under the name of Hallowell in 1771; and upon the setting off of Hallowell in 1797 became a separate town. In 1831 it became the capital of the State, and has been the scene of many important political events. It received a city charter in 1849. Its population in 1900 was 11,683; in 1910 it was 13,211; in 1914, 14,000. The employees of the cotton factories are mostly French Canadians, the other inhabitants chiefly natives. Consult North, 'History of Augusta' (1870).

AUGUSTA, the name of many ancient European towns, as Augusta Trevirorum, now *Treves;* Augusta Taurinorum, now *Turin;* Augusta Vindelicorum, now *Augsburg,* etc.

AUGUSTA, a city of Sicily. See Agosta.

AUGUSTA HISTORIA, a series of Roman biographies of the emperors from the accession of Hadrian to the death of Carinus, the predecessor of Diocletian, a period covering 167 years. The writers included in this collection are six in number, namely, Ælius Spartianus, Julius Capitolinus, Ælius Lampridius, Vulcatius Gallicanus, Trebellius Pollio, and Flavius Vopiscus.

AUGUSTALIA (Augustales ludi), games that were celebrated, not only in Rome, but wherever Roman authority was maintained, in honor of Emperor Augustus. They took place on 23 September, the birthday of Augustus, and on 1 August and during a period from 3 to 12 October.

AUGUSTAN AGE, the Latin literary epoch of the reign of the Emperor Augustus Cæsar. During this period Horace, Ovid, Virgil, Tibullus, and other writers flourished; also great patrons of literature like Mæcenas. The poets of the Augustan Age are noted for their pure Latinity. The name is applied in England to the reign of Queen Anne (1702–14). By far its foremost name is Isaac Newton, while of commanders is first, John Churchill (Duke of Marlborough). The poets were Congreve, Garth, Gay, Parnell, Philips, Pope, Prior, Rowe and Swift. The other authors were Addison, Barnes, George Bull, Anthony Collins, Jeremy Collier, Roger Cotes, Defoe, Dodwell, Flamsteed, George Hickes, Dr. John Jeffery, John Norris, Ray, South, Steele, etc. Wren, Archibald Pitcairne and Sir Cloudesley Shovel also lived in this reign.

AUGUSTANA COLLEGE AND THEOLOGICAL SEMINARY, institution in Rock Island, Ill., organized at Chicago in 1860 under the auspices of the Lutheran Church; removed to Paxton, Ill., in 1863, and to its present site in 1875. It is coeducational except in the theological department. In 1917 it had over 40 professors; 630 students; volumes in the library, 20,000.

AUGUSTINE, Saint (Aurelius Augustinus), one of the most renowned fathers of the Christian Church: b. Tagaste, in Numidia, 13 Nov. 354; d. Hippo, north Africa, 28 Aug. 430. His father, Patricius, was a pagan, his mother, Monica, a Christian. He has related his own early life in the work to which he gave the title of 'Confessions.' His mother instructed him in Christianity, but for many years this faith had little influence on his life. In youth and early manhood he was addicted to excessive sensuality, which he bitterly regretted in after life; when quite young he became father of an illegitimate son. He was intended for the profesion of rhetorician, and was sent to Carthage to study with this object in view. Cicero's work, 'Hortensius,' which has not come down to our times first led him to speculative studies, and he now became a member of the sect of the Manichæans. He was one of their disciples for nine years but after having obtained a full knowledge of their doctrine, he found it unsatisfactory and left them. In 383 he left Africa for Rome, and after a short stay there proceeded to Milan, where he was invited as a teacher of rhetoric. Saint Ambrose

was bishop of this city, and his eloquent discourses, combined with the study of the Scriptures, converted Augustine to the orthodox faith, and wrought an entire change in his life and character. His conversion appears to have taken place in 386. He now retired into solitude, and prepared himself for baptism, which he received in the 33d year of his life, together with his son Adeodatus, from the hands of Ambrose, his mother being then with him. Returning to Africa, he sold his estate, and gave the proceeds to the poor, retaining only enough to support him in a moderate manner. For three years he lived a retired life, devoting himself to religious duties, and to the composition of several treatises. Chancing on one occasion to be present in the church at Hippo, the bishop, who was a very old man, signified a desire to consecrate a priest to assist and succeed him. At the desire of the people Augustine entered upon the holy office, preached with extraordinary success, and in a few years became bishop of Hippo. The remainder of his life was occupied with his ecclesiastical labors, and with various controversies in which he warmly engaged, such as those with the Donatists, the Manichæans, and more especially the Pelagians, concerning the doctrines of free-will, grace and predestination. Augustine maintained the necessity of divine grace in determining man's moral acts to salvation, and he supported the doctrine of predestination, including election and reprobation, but always allowing for free-will and for the merit of the individual. His authority has always been very influential in the Roman Catholic Church, and his view upon any doctrinal matter has at all times carried great weight and is constantly cited in controverted questions. He died at Hippo, while the town was besieged by the Vandals. There have been more learned fathers of the Church, but none have ever more powerfully touched the human heart, and warmed it toward religion. Painters have, therefore, given him for a symbol a flaming heart. His writings (which are in Latin) are very numerous. The most celebrated are his 'Confessions' (belonging to the year 397), his 'De Civitate Dei' (On the City of God), a work on the Christian Church, his treatise on the Trinity, 'Christian Doctrine'; 'Nature and Grace'; 'Grace and Free-Will'; 'Immortality of the Soul,' and his 'Letters.' His works have been published at Paris in 22 volumes, and an English translation in 15 volumes has appeared at Edinburgh, edited by Dr. Marcus Dods. The standard edition is that issued by the Vienna Academy in its 'Corpus Scriptorum Ecclesiasticorum Latinorum.' Most of Augustine's important works may be found in Schaff, P., 'Nicene and Post-Nicene Fathers' (New York 1888). Consult Smith and Wace, 'Dictionary of Christian Biography' (London 1887); Neander, 'Church History'; Milman, 'Latin Christianity'; Farrar, 'Lives of the Fathers'; Harnack, 'History of Dogma,' Eng. trans. (Vol. V, Boston 1898); Cunningham, 'Saint Austin and his Place in the History of Christian Thought' (London 1885); Allen, A. V. G., 'Continuity of Christian Thought' (Boston 1894), an unfavorable view of Augustine, etc. Two monastic bodies, the *Augustinian Canons*, or *Black Canons*, and the *Augustinian Hermits* (q.v.), claim to derive their origin from Saint Augustine. There are several translations of 'The Confessions,' e.g., by W. G. T. Shedd (Andover 1860) and C. Bigg (London 1900). See also Hitchcock, F. R. M., 'Saint Augustine's Treatise on the City of God' (London 1900).

AUGUSTINE, or **AUSTIN, Saint,** the first archbishop of Canterbury: d. 26 May 604. While prior of the Benedictine monastery of Saint Andrew at Rome he was selected by Pope Gregory I, together with other monks, to convert the Anglo-Saxons to Christianity, and establish the authority of the Roman See in Britain. Arriving at Aix-en-Provençe, they heard various reports about the savage nature of the Britons, and hesitated before proceeding further. Augustine went to Rome to seek permission to turn back, but Pope Gregory prevailed on him to continue, and asked the Frankish clergy to assist the enterprise. Therefore in the spring of 597 the missionaries landed on the Island of Thanet and were kindly received by Ethelbert, King of Kent, whose wife Bertha was already a Christian. The conversion of the King speedily followed, contributing greatly to the success of Augustine's work; large numbers of persons were converted and baptized, and it was soon manifest that a new influence for good had come into the lives of the Anglo-Saxons. In acknowledgment of his success, the Pope directed Augustine in 597 to go to Arles, where he was consecrated archbishop of Canterbury and metropolitan of England. On his return he at once informed the Pope of his success, sending a presbyter and a monk to Rome for that purpose and also to obtain instructions concerning other questions with regard to the propagating of the faith. The answers of Gregory to the archbishop's inquiries are fine examples of tact, good sense and judgment in dealing with the problems confronting the early missionaries, and instead of destroying the heathen temples they were converted into Christian churches. Saint Augustine was a zealous missionary of the Church and labored with untiring energy to extend the authority of the Church and to convert the ancient Britons, whom the English had driven into the mountains of Wales. In this, however, he was only partially successful, some of the British bishops refusing to acknowledge his authority and to unite with the English Church. Augustine died in Canterbury perhaps in 604, though the year is uncertain and is placed by some as late as 613, and his body was removed to the Cathedral of Canterbury in 1091. The 1300th anniversary of Augustine's landing was celebrated in 1897, when several biographical volumes appeared — by E. W. Benson, Father Brou, S. J., G. F. Browne and W. E. Collins. Consult also Bede, 'Historia Ecclesiastica Gentis Anglorum'; Cooke, J. A., 'Early Churches in Great Britain Prior to the Coming of Augustine' (London 1897); Mason, 'The Mission of Saint Augustine to England' (Cambridge 1897); and Stanley, 'Historical Memorials of Canterbury' (New York 1892).

AUGUSTINIANISM, the system of philosophy and theology taught by Saint Augustine. In order to reach a just estimate of the teachings of Augustine, we must remember that we are not dealing with a philosopher simply, or with a theologian simply, but with

one whose nature combined in a marked degree the philosophical and theological strains together. He was both philosopher and theologian. These elements are so mixed in him at times as to reciprocally reinforce one another, but again so disparate as to cause irreconcilable inconsistencies and bold contradictions. There is a most excellent analysis of this exceedingly complex nature by Teuffel in his 'History of Roman Literature,' remarkable alike for its comprehensiveness and brevity. "Augustine combined in his character qualities seemingly opposite: an abundant imagination, and penetrating intellectual vigor, a passionate want of regard and affectionate tenderness, a tender heart and zealotism, a blind belief in superior authority and originality of thought, zeal for unity of the Church and individual piety, romanticism and scholasticism, mysticism and sophistry, poetical talent and philosophical genius, rhetorical pathos and grammatical pedantry — himself a pyschological mystery." With this portrait of his personality before us, let us examine his teachings. For him, the source of all truth is to be found in the interpretation of the inner experience. His philosophy is primarily anthropocentric. In consciousness lies the assurance of the reality of one's own being. This is the earnest and the warrant of all reality. Without this central and elemental knowledge all other knowledge would be vague and illusory. This assurance is given even in the very act of questioning it; for, as Augustine insists, the simple fact that I am conscious of doubting, even the doubting of my own reality, is in itself an indication that I the doubter am. Man cannot escape himself. Such an analysis of the implications of self-consciousness forms a striking anticipation of Descartes' famous *Cogito ergo sum.*

With the reality of human personality firmly established upon a basis which even the most searching scepticism is unable to shake, but on the contrary the rather confirms, Augustine proceeds through a profound analysis of the human reason to disclose abundant intimations of a divine reason, and therefore of a divine being. For in his subtle examination of the processes of reason, he points out that these processes are ever working toward one and the same end,— the constructing of a body of knowledge consisting of truths universally valid, that is truths which hold not merely for the individual but which necessarily hold for all individuals, under all circumstances and at all times. They become, moreover, the norm or standard for all our thinking and their sway embraces the complete range of all human activity. These truths are so universal, so complete, so commanding as to indicate a oneness of origin which can be nothing less than that of an eternal mind. Moreover, the eternal mind must be an eternal personality. The universal truths, therefore, which lie at the basis of all thought, of all being, of all desire, and all activity are according to Augustine ideas in God. In regarding the Absolute as not merely the sum total and unification of all truth, the *unum, verum bonum,* but also a living personality, the divine Logos, we recognize the marks of the religious teacher, and in this respect Augustinianism is to be regarded as a significant advance beyond the doctrines of Neo-Platonism. From this exposition, it should not be inferred, however, that in the Augustinian psychology, the primary, or the sole, basis of our conscious life is knowledge. On the contrary it is quite evident throughout the works of Augustine that he exalts the will above knowledge. He finds in consciousness three elements, *memoria, intellectus, voluntas.* Of these *memoria* is equivalent to a reproducible idea (*Vorstellung*), an idea which, moreover, carries with it the warrant of the reality which underlies it as its ground; *intellectus* is the judgment; and *voluntas* of course, the will. The three form a psychological trinity corresponding to the trinity which is manifested in the unity of the divine nature. Both in God and man, the will is supreme. *Omnes nihil aliud quam voluntates sunt.*

Certain difficulties emerge at this point in the exposition of the Augustinian system owing to the shifting of the point of view. The philosopher gives way to the theologian. Augustine's philosophy is essentially anthropocentric; his theology, theocentric. And in discussing the relations which obtain between God and man Augustine naturally subordinates the human to the divine, so much so indeed that the Augustinian system is severely criticised because, as it is alleged, it leads logically to a pantheism which wipes out the individuality and responsibility of man. For Augustine insists that to appreciate divine truth and the will of God for man there is need of an inner spiritual illumination, and that such an illumination comes only to the soul in which faith resides, and that faith is the gift of divine grace. Faith, therefore, must precede knowledge, that is, knowledge of things divine and knowledge of things as they are. Insight may be regarded as the fruitage, but faith is the root of knowledge. There is a grave difficulty at this point in reconciling such a doctrine with Augustine's fundamental position which puts supreme emphasis upon the dignity and worth of man's inner nature, and the trustworthiness of that inner guiding light. It can only be said by way of explanation that in the one the theologian, and in the other, the philosopher, speaks.

Moreover, in this view of the human consciousness the primacy of the will is in a large measure denied by the insistence that man is wholly dependent upon divine grace in order to exercise his will aright. He alone is free, says Augustine, whose will has been touched by the divine will, and whose desires and activities are found wholly in accord with the will of God. The natural man is not free unless emancipated by divine grace; for Adam, the representative of humanity, the federal head of the race, abused his natural freedom of will and in his fall has left as an inheritance to the race the tendency to sin. And the most significant consequence of sin is the bondage of the will, which divine grace alone can overcome. Augustine, therefore, seems to solve the problem of free will and predestination by denying to man a real freedom. He indulges in many subtle distinctions as to the various kinds of grace. There is, for instance, the prevenient grace, also the supporting grace, active grace, and grace bestowing the gift of perseverance which seals all previous effects.

No distinction, however, is drawn which relieves the system from the criticism already mentioned of minimizing the autonomy of the human will.

This position of Augustine naturally raises the question as to how the evil in the world can be reconciled with the idea of divine power and divine goodness. For if God alone is free, He alone is responsible; and man should not be held accountable for that which he unaided is unable to prevent. Such a criticism Augustine meets by the statement that the evil in the world is after all not a real evil; it is not a *causa efficiens,* but merely a *causa deficiens,* in fact only an *incausale.* Such an explanation, however, is not satisfactory and does not squarely meet the difficulty of the problem which the common experience of humanity all too unhappily emphasizes.

Augustine's type of mind is essentially that of a great systematizer of doctrine. He could rest content with no form of knowledge unless it could be reduced to a *schema* in which part fitted to part in an exact and inflexible manner. Augustine's system has been criticized for this very reason that its lines are hard and fast, yielding at no point the full rigor of its inexorable doctrines. But while in a certain sense such criticism is justified, there was, in addition to this pronounced synoptical tendency of thought, an equally profound strain of sentiment and feeling. Augustine was essentially human, and wont to be moved by the passions and aspirations common to man. Within the very body of this system of doctrine, and its closely concatenated dogmas, it is possible to discover a deep underlying current of mysticism, which may be traced no doubt to its source in Neo-Platonism,—a mysticism manifesting itself in that compulsion of the soul, to long for communion with God, and to behold Him face to face. It is this intensely human strain, this mystical element, which relieves the Augustinian system as a system from its more severe and sombre features. The great system builder after all subordinates the system to that which is the ground of the system. Not in the processes of reason, but in a direct and immediate consciousness of God, does he find the ultimate certitude. Nothing can more beautifully or more adequately express this mystical strain in Augustine's nature than those words which embody both a philosophy and a creed: "Thou hast made me for thyself and my heart is restless until it finds rest in thee."

Bibliography.— Heurt, 'Problems of the Age With Studies in Saint Augustine on Kindred Topics' (1903); McCabe, 'Saint Augustine and His Age' (1903); Schaff, 'Saint Augustine, Library of the Nicene and Post-Nicene Fathers' (Vol. I, pp. 1–25, New York 1888); Donier, 'Augustinus' (Berlin 1872); Lingard, 'Antiquities of the Anglo-Saxon Church' (2d ed., 1902).

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AUGUSTINIANS. The name of about 60 different monastic bodies in the Roman Catholic Church, all of which deduce their community rules from the sermons or writings of Saint Augustine, bishop of Hippo. The chief of these were the "Hermits of Saint Augustine," or Begging Hermits; the "Friars Preachers," or Dominicans; the "Knight Templars," the Premonstratensians and the "Canons Regular."

Hermits of Saint Augustine (calced), brotherhood of churchmen, devoted to the spread throughout Christendom of the principles of the higher life, of religion as well as earthly science, and searchers, too, after peace of the spirit, established in the 4th century at Tagaste in Africa. Up to the 13th century Augustinians were engaged mainly in the practices of ascetic life, a course of seclusion, or retirement, from the bustle and troubles of worldly affairs in trade, politics, commerce. As hermits, at first they lived, some alone in their cells in out-of-the-way places in forest and mountain, others in community-groups outside of towns. Here their life was passed in quiet, in contemplation, study, prayer, copying manuscripts and manual toil, as farm and garden work, reclaiming waste lands, digging canals for irrigation and drainage. Eminent among them in this peaceful era were two reformers of their brotherhood, famed in hagiography, who by centralizing the energies of their followers on set lines of work sought to render their societies more potent factors for the common good, as adepts in intellectual, artistic and more industrial spheres. William of Aquitaine, a dweller in a monastery of the Tuscan hills, and John Bonus, The Good, of Mantua, a one-time strolling player by profession, now penitent, who by their wonderful powers of nature and grace employed in the service of their respective communities, reached high rank in the world of saintly heroism in southern Europe, in France and Italy, then in the north, in Germany and England, wherein were founded congregations under their rule. Spreading thence throughout the various quarters of Christendom, especially in western Europe, their followers settled in Spain, Portugal, Belgium and Ireland, where they established houses of their brotherhood in the principal cities and towns of the then civilized world. In 1256, in pursuance of the designs of his predecessors in the papal chair, Alexander IV moved to ensure the complete union of all the different congregations of Augustinians in Europe, succeeded finally in merging their several branch orders into one body politic and social under the leadership of Lanfranc Septala, of noble Milanese birth, the first superior-general of the Augustinian Hermits, chosen thereto in the first general chapter of the brethren at Rome in the above year. Nor were the successors of Alexander slow in their recognition of the powers of this new association. To them were entrusted several places of honor in the pontifical court, among them the offices of apostolic confessor, of librarian, papal sacristan, the latter subsequently declared by Sixtus IV as of perpetual right of the Augustinians. Not long after they were entrusted with the collection of papal revenues in many countries, and even charged by some of the republics of Italy with the handling of state funds.

In the Middle Ages as in later days many of this brotherhood won fame in the higher realms of life, by their gifts of spirit in science and art, as saints, writers, masters in theology, Scripture-study, philosophy, history, law, antiquities, letters and poetry. Celebrated as teachers in schools of their order as well as

outside were such masters as Egidius Colonna of Rome, known as the "Fundamental Doctor"; then Augustine of Ancona, who won renown in scholastic theology; John Capgrave in history; Onuphrius Panvinio in antiquities; Luis de Leon in theology and poetry; John Laurence Berti in history; John Baptist Cotta in poetry; John Michael Cavalieri in liturgy, and lately Augustine Ciasca in Oriental languages. Eminent for their supernatural gifts, many of the most singular character, were Nicholas of Tolentine, "wonder-worker of the Church," so styled by Pope Eugene IV; Clare of Montefalco, the stigmatized, in whose heart were discovered the insignia of Christ's passion; Rita of Cascia, ecstatic, known as "the saint of the impossible"; Thomas of Villanova, almsgiver of Spain, and John de Schagun, reformer of the clergy of that country. The Augustinians are of prominence from the 16th century especially in various mission fields in Mahometan and heathen countries; in Asia, in China, India, Persia, Japan and the Philippines; in Africa, in Zanzibar, Mozambique and the Guineas; then in America, both North and South, and Australia. In later times during the closing years of the 18th century, was established the first English-speaking branch of the Augustinians in the United States, where, in 1796, a house of that brotherhood was opened in Philadelphia by two members of Irish blood — Dr. Matthew Carr and John Rosseter — the latter said to have been formerly an officer under Rochambeau. Such was the genesis of the calced communities. In the United States their aim chiefly has been mission work among the faithful in pulpit and school. Offshoots from Philadelphia, now thriving in the United States as well as in Cuba and the Philippines, are some 23 convents and houses of the order, as mission-centres, with more than 100 members in residence or in study-houses in Europe. Furthermore attached to every central establishment the Augustinians have charge of various guilds, or societies, devoted to such aims as religion, social improvement, beneficence in the promotion of good works in the several fields of charity, patriotism, letters and science.

The Canons Regular or *Austin Canons* trace their descent as an order from the 11th century. Their rules were scarcely more rigid than that of the secular clergy and were far less severe than that of monks. They were all in sacred orders (ordained clergy) and thus differed from the monks who included in their number many lay brothers. The canons lived together and had a common refectory. From their long black hoods they were popularly called Black Canons. They established themselves in England about the beginning of the 12th century and had over 160 monasteries there at the time of the dissolution of the latter by Henry VIII. Ireland had over 200 establishments of this order and several nunneries, while Scotland had about 25 monasteries of which the earliest was at Scone. The abuses which crept into the various orders in the 14th and 15th centuries led to several new or reformed Augustinian bodies, among which was the Saxon congregation to which Luther belonged. Shortly after the revolution of 1789 the order was entirely suppressed in France, Spain and Portugal, and in parts of Italy and Germany. It is at present strongest in the two Americas. For the other divisions — Dominicans, Knight Templars and Premonstratensians see special articles under those heads and consult Allin, 'The Augustinian Revolution in Theology' (London 1911); Clark, 'Customs of the Augustinian Canons' (Cambridge 1897); 'Observances at the Augustinian Priories of Saint Giles and Saint Andrews at Barnwell, Cambridge' (London 1897).

AUGUSTOWO, ou'gus-tō'vō, Russian Poland, city in the government of Suwalki, situated on a large lake on the Netta River, a tributary of the Bug. It is situated at one terminus of the Augustowo Canal, which connects the Netta with the Niemen River. Its principal industries are its river and lake fisheries and textile manufactories. It is also the centre of quite an extensive cattle and lumber trade. Pop. about 15,000.

AUGUSTULUS, Romulus, the son of Orestes, a general of the Roman Emperor Julius Nepos. Orestes deposed the Emperor and placed his son upon the throne in 475. In the following year Odoacer, a commander of the German forces in the Roman service, revolted, put Orestes to death, obliged Augustulus to resign and thus put an end to the Roman empire in the west. Augustulus, being of too little importance to be put to death, was sent to a villa near Naples, with a yearly pension of 6,000 gold solidi. The rest of his life was passed in obscurity. The Emperor's name was originally Romulus Augustus, but the Romans changed the latter into the diminutive form Augustulus, out of contempt for his character.

AUGUSTUS, Gaius Julius Cæsar Octavianus, originally called GAIUS OCTAVIUS, the celebrated Roman Emperor: b. 23 Sept. 63 B.C.; d. Nola, 19 Aug. 14 A.D. He was the son of Gaius Octavius and Atia, a daughter of Julia, the sister of Julius Cæsar. The Octavian family originated at Velitræ, in the country of the Volscians. The father of Octavius had risen to the rank of senator, and had gone to Macedonia, after being chosen prætor, where he was a civil and military officer. Octavius lost his father when young, but was carefully brought up by his mother and L. Marcius Philippus, the second husband of Atia. His talents gained him the regard of his great-uncle, Julius Cæsar, who declared himself willing to adopt him as his son in case he himself should remain without children. Octavius was studying under the renowned orator Apollodorus when he received the news of the tragic death of his uncle and of his having adopted him as his son. Notwithstanding the anxiety of his friends, he went to Italy, and on landing at Brundusium, deputies from the veterans collected there came to him. Conducted in triumph to the city and saluted as the heir and avenger of Cæsar, he made his adoption publicly known and took the name of his uncle, adding to it that of Octavianus. He then advanced to Rome, where there were now two parties, that of the republicans, who had killed Cæsar, and that of Antony and Lepidus, who, under the pretense of avenging him, strove to establish their own authority. Octavianus addressed himself first to Cicero, at Cumæ, being desirous to gain over this great orator, and from thence he went to Rome, where the greater part of the magistrates, soldiers and citizens came to meet him, Antony alone paying no attention to his return. After

Octavianus had caused his adoption to be confirmed in the most solemn manner, he went to Antony and demanded of him the inheritance left him in order to pay the legacies mentioned in his uncle's will. Antony at first haughtily refused to acknowledge his claims, but changed his attitude when he found the influence of Octavianus continually increasing, and his own proportionably diminishing. There could be no real union, however, between two equally ambitious rivals. In their hearts they cherished reciprocal hatred and jealousy; and their enmity was so little a secret that Octavianus was accused of having wished to get Antony murdered. He afterward, when Antony, together with Lepidus, entered Italy at the head of a powerful army, united with him, and a triumvirate was formed by the three generals, who defeated the republican army under Brutus and Cassius, at Philippi in Macedonia (42 B.C.). After his return to Rome he satisfied the demands of his soldiers by dividing among them confiscated lands. This division caused great disturbances. In the midst of the stormy scenes which convulsed Italy, he was obliged to contend with Fulvia, whose daughter, Clodia, he had rejected, and with Lucius, the brother-in-law of Antony. After several battles, Lucius threw himself into the city of Perusia, where he was soon after obliged to surrender. The city was given up to be plundered, and 300 senators were condemned to death. After the return of Antony an end was put to the proscriptions. Octavianus allowed such of the proscribed persons as had escaped death by flight, and whom he no longer feared, to return. There were still some disturbances in Gaul, and the naval war with Sextus Pompeius continued for several years. By a skilful course of conduct he brought about the defeat of Pompeius and reduced Lepidus to a nullity, thus leaving Antony alone as his rival. The empire was now divided between him and Antony; but while the former, in the east, gave himself up to a life of luxury, the young Octavius pursued his plan of making himself sole master of the world. He especially strove to obtain the love of the people. He displayed mildness and magnanimity, without the appearance of striving after the highest power, and declared himself ready to lay down his power when Antony should return from the war against the Parthians. He appeared rather to permit than to wish himself to be appointed perpetual tribune — an office which gave him supreme power. The more he advanced in the affections of the people the more openly did he declare himself against Antony.

By making public a will, wherein his rival appointed his sons by Cleopatra his heirs, he stirred up the ill-will of the Romans against him. Availing himself of this feeling, Octavianus declared war against the Queen of Egypt and led a considerable force, both by sea and land, to the Ambracian Gulf. Here his admiral Vipsanius Agrippa gained the naval victory of Actium (q.v.), which made Octavianus master of the world, 31 B.C. He pursued his rival to Egypt, and ended the war, after rejecting the proposal of Antony to decide their differences by a personal combat. Cleopatra and Antony having killed themselves, Octavianus caused them to be buried with imposing ceremonies. A son of Antony and Fulvia was sacrificed to ensure his safety, and Cæsarion, a son of Cæsar and Cleopatra, shared the same fate. All the other relations of Antony remained uninjured, and Octavianus, on the whole, used his power with moderation. He spent two years in the East, in order to arrange the affairs of Egypt, Greece, Syria, Asia Minor and the islands. On his return to Rome he celebrated a triumph for three days in succession, and (29 B.C.) closed the temple of Janus — for the third time since the foundation of Rome. Freed from his rivals and enemies, and master of the world, he is said to have been undecided as to how he should exercise his power, or whether he should even retain it. He first set about correcting the abuses which had prevailed during the civil war, established a general peace, ejected unworthy members from the Senate, restored ruined temples and built new ones.

At the end of his seventh consulship, he entered the Senate house, and declared his resolution to lay down his power. The Senate, astonished at his moderation, besought him to retain it. He yielded to their pressing entreaties, and continued to govern through them. He now obtained the surname of Augustus, which marked the dignity of his person and rank, and united, by degrees, in himself, the offices of imperator, or commander-in-chief by sea and land, with power to make war and peace; of proconsul over all the provinces; of perpetual tribune of the people, which rendered his person inviolable, and gave him the power of interrupting public proceedings; and, in fine, of censor, and pontifex maximus, or controller of all religious matters. The laws themselves were subject to him, and the observance of them depended upon his will. It was the spirit of his policy to retain old names and forms, but he steadfastly refused to assume the title of dictator, which latterly had become especially odious. He conducted many wars in Africa, Asia, and particularly in Gaul and Spain, where he triumphed over the Cantabrians after a severe struggle. His arms subjected Aquitania, Pannonia, Dalmatia and Illyria, and held the Dacians, Numidians and Ethiopians in check. He concluded a treaty with the Parthians, by which they gave up Armenia, and restored the eagles taken from Crassus and Antony. At the foot of the Alps he erected monuments of his triumphs over the mountaineers, the proud remains of which are yet to be seen at Susa and Aosta. After he had established peace throughout the empire, he again closed the temple of Janus. But this peace was interrupted, 9 A.D., by the defeat of Varus, who lost three legions in an engagement with the Germans, under Arminius, and killed himself in despair. The information of this misfortune greatly agitated Augustus. He let his beard and hair grow, and often cried out in the deepest grief, "O Varus, restore me my legions!" Meanwhile the Germans were held in check by Tiberius. During the peace, Augustus had issued many useful decrees, and abolished abuses in the government. He gave a new form to the Senate, employed himself in improving the manners of the people, particularly by promoting marriage, enacted laws for the suppression of luxury, introduced discipline into the armies, and order into the games of the circus. He adorned Rome in such a manner that it was truly said, "He found it of brick, and left it

of marble.» He made journeys, as Velleius says, everywhere, to increase the blessings of peace; he went to Sicily and Greece, Asia Minor, Syria, Gaul, etc.; in several places he founded cities and colonies. The people erected altars to him, and, by a decree of the Senate, the month Sextilis was called August. The debauchery of his daughter Julia gave him great pain, and he showed himself more severe against those who destroyed the honor of his family, than against those who threatened his life. History says that, in his old age, he was ruled by his wife, Livia, the only person, perhaps, whom he truly loved. He had no sons, and lost by death his sister's son, Marcellus, and his daughter's sons, Gaius and Lucius, whom he had appointed his successors. Also, Drusus, his son-in-law, whom he loved, died early; and Tiberius, the brother of the latter, whom he hated, on account of his bad qualities, alone survived.

These numerous calamities, together with his continually increasing infirmities, gave him a strong desire of repose. He undertook a journey to Campania, from whose purer air he hoped for relief; but disease fixed upon him, and he died, in the 79th year of his age, and 45th of his reign. When he felt his death approaching he is said to have called for a mirror, arranged his hair, and demanded of the bystanders, «Have I played my part well?» and, an answer being returned in the affirmative, «Then,» added he, using the form of the players, «farewell, and applaud» (*valete, et plaudite*). If this last passage in the life of Augustus is true, it is certainly indicative of his character, his policy, and even of his fortune. He conquered Brutus by means of Antony, and Antony by means of Agrippa. He several times changed his party, but never his purposes, and knew how to cause power to be offered, and pressed upon him, while it was, in fact, the object of all his exertions. It cannot be denied that he used his power with wisdom, and became the benefactor of his country, which he had previously plunged into the horrors of civil war. His taste and active mind led him to favor and protect the learned; and he even exercised the art of the poet himself; so that he was not unworthy of giving his name to an age distinguished for intellectual creations. His death plunged the empire into the greatest grief. He was numbered among the gods, and temples and altars were erected to him. Consult Beulé, 'Auguste, sa famille et ses amis' (Paris 1867); Boissier, 'La religion romaine' (1883); Gardthausen, 'Augustus und seine Zeit' (Leipzig 1891); Firth, J. B., 'Augustus Cæsar' (New York 1903); Schuckburg, 'Augustus' (1903).

AUGUSTUS I, Elector of Saxony: b. Freiburg 1526; d. 1586. He spent some time at Prague in his youth, and became a close friend of Maximilian, afterward the Emperor Maximilian II. He married the daughter of Christian III of Denmark who was very popular. In 1553 Augustus succeeded his brother Maurice as Elector. At first he favored the Calvinists, but later adopted Lutheranism. His internal administration was remarkable for many beneficent reforms in jurisprudence and finance. He also aided education, manufactures and commerce. He ordered that every newly-wedded couple should plant two fruit trees within the year following their marriage. He greatly beautified Dresden, his capital and founded the library there. He married for the second time a few weeks before his death. Consult Falke, 'Geschichte des Kurfürsten August von Sachsen' (Leipzig 1868).

AUGUSTUS II, Frederick («The Strong»), Elector of Saxony and King of Poland, second son of John George III, Elector of Saxony: b. Dresden 1670; d. 1 Feb. 1733. He was noted for his activity. In 1695 he became Elector and in 1696 was candidate for the vacant Polish throne. The French Ambassador and the nobles supported the Prince of Conti, but Augustus by acceptance of the Roman Catholic faith, by bribery and intimidation secured the election, 27 June 1697. Early in his reign, a treaty was made between Denmark, Poland and Russia against Charles XII of Sweden, for the conquest of Livonia. But Charles, after having defeated the Danes and the Russians, turned toward Poland. Thus began the celebrated Northern War, which lasted 20 years. Charles gained a complete victory, 20 July 1702, and on 1 May 1703, the Saxon army was defeated again at Pultusk. The Diet assembled at Warsaw declared Augustus, 14 Feb. 1704, incapable of wearing the crown of Poland, and Stanislaus Lesczinsky, Waywode of Posen, was chosen king, 12 July 1704. Charles victorious on every side, advanced into Saxony, and Augustus found himself obliged to negotiate a secret peace, at Altranstadt, 24 Sept. 1706.

He now devoted himself to the domestic affairs of Saxony. His love of splendor involved him in many expenses, by which the finances of his kingdom were disordered. In 1709, after the defeat of Charles at Pultowa, the Poles recalled Augustus, who united himself anew with Peter the Great. A confederation was now formed in Poland against the Saxon troops, by the party of Stanislaus, in the belief that Augustus was aiming at absolute power. The Saxons were attacked and obliged to surrender. At length, through the mediation of Peter, an arrangement was concluded at Warsaw, 1717, between Augustus and the Polish leaders. The Saxon troops were removed from the kingdom, and Augustus agreed not to maintain more than 17,000 soldiers in Poland, who were to be under the Polish authorities. The last years of his reign were characterized by boundless luxury and corruption of manners. He was not disliked by his subjects, and filled with dignity his station among the European powers. In his character generous ideas were united with despotic feelings, a taste for pleasure with the cares of ambition, and the restlessness of a warlike spirit with the effeminacy of a luxurious life. By his mistresses he had many children. The Countess of Königsmark bore him the celebrated Maurice of Saxony. He left an only son who succeeded him. Consult Desroches de Parthénay, 'Histoire de Pologne sous le roi Auguste' (The Hague 1734).

AUGUSTUS III, Frederick, Elector of Saxony and King of Poland, son of Augustus II: b. Dresden 1696; d. there, 5 Oct. 1763. He succeeded his father as Elector in 1733. A part of the Polish nobility chose Augustus king; and in 1736 he was first generally recognized as

such by the Congress assembled at Warsaw to conclude a peace. Although without the great and amiable qualities of his father, in other respects he closely followed his example, distinguishing himself by the splendor of his feasts and the extravagance of his court. His system of politics consisted in entire dependence upon Russia. He preferred Dresden to Warsaw, and through his long absence from Poland the government sank into entire inactivity. When Frederick attacked Saxony itself in 1745, Augustus deserted his capital, and preserved his pictures and porcelain, but lost the archives of the state, which fell into the hands of the victors. By the peace of Dresden, 25 Dec. 1745, he was reinstated in the possession of Saxony, in the next year. In 1756 he saw himself involved anew in a war against Prussia, and fled to Königstein, and afterward to Poland. His authority in this country had always been inconsiderable, and after the loss of Saxony, became still more insignificant. The accession of Catharine to the Russian throne was a source of disquietude, for she sought to deprive the Saxon princes, who were allies of France, of the Polish thrones. The peace of Hubertsberg was hardly concluded when Augustus returned from Warsaw to Dresden, where he died. His son, Frederick Christian, succeeded him as Elector of Saxony, and Stanislaus Poniatowsky as King of Poland. Consult Ruthière, 'Histoire de l'anarchie de Pologne' (Paris 1819).

AUGUSTUS, Apotheosis of, a celebrated cameo, cut out of sardonyx, nearly a foot in diameter. It is the largest work of its kind. It contains 26 figures, formerly supposed to represent Joseph leading a procession through Egypt. It is now one of the gems of the Cabinet des Medailles et Antiques in Paris.

AUGUSTUS, Arch of, a triumphal arch erected in the Roman Forum in honor of Augustus, about 20 B.C. Destroyed in 1540, its foundations were discovered in 1888. Consult Hülsen-Carter, 'The Roman Forum' (Rome 1906).

AUGUSTUS, Forum of, the Imperial forum built by Augustus at Rome. Portions of its walls still remain, with ruins of the temple of Mars Ultor, which was built in the centre in commemoration of the battle of Philippi and the retribution brought by Augustus on the murderers of Cæsar. Consult Platner, 'The Topography and Monuments of Ancient Rome' (New York 1911).

AUGUSTUS, Mausoleum of, a circular structure of huge diameter (280 feet), built of white marble and covered by a mound of earth, on which were planted evergreen trees. At the summit of the mound, among the shrubbery, was placed a colossal bronze statue of Augustus, who had caused the mausoleum to be built, 28 B.C. On each side of the portal stood an obelisk, still preserved in the Piazza del Esquilino and the Piazza del Quirinale. Within were interred the great Romans honored by the Emperor, the first being young Marcellus and the last Nerva, 98 A.D. Later the structure was allowed to fall into ruins, was for a time used as a bull ring and a circus and now only the brick shell is visible.

AUK, âk, a diving sea-fowl of the family *Alcidæ* found in the northern regions, the term covering guillemots, murres, lomvias, puffins and others. They are thick-set birds, seldom more than a foot long, which move about with difficulty on land, from the fact that their legs are set very far back, giving them an erect, penguin-like attitude. In color they are dark brown, black or lead-color above, and white beneath, except in the breeding season, when bright colors and ornamental plumes temporarily appear on the males of some species. The wing-feathers are so short as to be of little service for flight, and the wings are more used as aids in swimming under water, where they pursue fishes with great speed. The bill is much compressed, but in the breeding season, among the puffins, which show the most marked compression of bill at other times, the bills increase in size and develop ornamental appendages which disappear as the moulting season comes on. The most important north Atlantic auks are the now-extinct great auk (*plautus impennis*) which was as large as a goose and within historic times abounded as far south as the Hebrides (see GAREFOWL); the little auk (*Alle alle*), not larger than a robin and very abundant, sometimes in winter coming as far south as New York and the Great Lakes (see DOVEKIE); and the razor-billed auk (*Alca torda*), which has a bill of remarkable length and sharpness, and which breeds even as far south as the Maine coast (see MURRELET; PUFFIN; RAZOR-BILL). The auk lays only a single large egg, which, as no nest is prepared, the parents care for by holding upon the top of their webbed feet and between their thighs. These eggs are a staple food for the natives of the Arctic regions, as are the birds, also. They are taken in summer and preserved for winter use, as in the autumn the auks migrate from the frozen coasts and spend the winter in the open spaces of the sea. Consult American and British ornithologies; and Grieve, 'The Great Auk' (London 1885); Stejneger, 'Bulletin of the United States National Museum No. 29' (1885); 'Harriman Alaska Expedition' (Vol. II, New York 1902); Selous, 'Bird Watching' (London 1901).

AULARD, ô'lär', **François Victor Alphonse,** French historian: b. Montbron, Charente, 1849. He is considered one of the best authorities on the French Revolution, of which subject he was professor at the Sorbonne. Among his many works are 'Les orateurs de l'assemblée constituante' (1882); 'Le culte de la raison et le culte de l'être suprême' (1892). He also edited 'La société des Jacobins' (6 vols., 1889–97).

AULD LANG SYNE, âld lạng sīn, a song attributed to Burns, who added a couple of stanzas to a poem known to have existed in 1600 and set to an old Lowland air by George Thompson. Consult Grove, 'Dictionary of Music and Musicians' (New York 1910).

AULD LICHT IDYLLS, âld lïcht ī'dïlls, a work by James M. Barrie. It is a series of 12 sketches of life in Glen Quharity and Thrums. In all of them the same characters appear.

AULD ROBIN GRAY, a famous Scottish ballad by Lady Anne Barnard, published anonymously in 1772, but unacknowledged till 1825. She afterward wrote a sequel to the ballad.

AULIC COUNCIL, one of the two highest courts of the Holy Roman empire (Reichshofrath), the other being the court of the Imperial Chamber (Reichskammergericht). It was at first a paid Council of the Emperor, and was reorganized 1497 by Maximilian I, who set it up as a rival to the Imperial Chamber, which the Diet had forced upon him. At first its main functions appear to have been in regard to the business administration of the crownlands and the empire in general, and so to facilitate and expedite the decisions of the Imperial Chamber. In the course of time other functions devolved upon it and it received a fixed constitution in 1559. Its powers were greatly limited by the Peace of Westphalia in 1648, but six years later it was formally constituted as one of the two supreme courts of the empire, the equal of the Imperial Chamber, and the highest Court of Appeals in the empire. In this form it consisted of a president, vice-president, a vice-chancellor and 18 councillors, all of whom were selected and paid by the Emperor, except the vice-chancellor, who was appointed by the Elector of Mainz. Its seat was at the Imperial residence, Vienna. It had jurisdiction in all matters concerning the reserved rights of the Emperor, all questions of appeal on the part of the states from decisions in minor courts, and whatever concerned the Imperial jurisdiction in Italy. It was dissolved on the death of the Emperor, and had to be reinstituted by his successor. Six of the councillors were Protestants, who could thus exercise an effective veto and preserve religious parity. The council ceased to exist on the fall of the Holy Roman empire in 1806. The title is now applied in Germany in a general sense to the chief council of any department, political, administrative, judicial or military. Consult Herschenhahn, 'Geschichte des kaiserlichen Reichshofraths' (Mannheim 1793).

AULICH, ou'lih, **Ludwig,** Hungarian general: b. Presburg 1792; d. Arad, 6 Oct. 1849. When the Hungarian Revolution of 1848 broke out Aulich was lieutenant-colonel in an Austrian regiment, which afterward took up the Hungarian cause. He was later made general of the 2d Hungarian army corps, in which capacity he was an important factor in the victories over Prince Windischgrätz. After the evacuation of Pesth by the Imperial troops in 1849, Aulich made his triumphant entry into that capital, and was received with enthusiasm by the people. In his famous proclamation of Gödöllö, Kossuth paid also an appropriate homage to Aulich's gallantry. Subsequently, when Görgey was forced to renounce either the army or the Minister of War, he took the latter alternative, and Aulich was appointed his successor. But although he might have used his authority as Minister of War to frustrate Görgey's negotiations with the Russians, he actually assisted Görgey to bring these negotiations to a successful close. He was then delivered over to Austria by the Russians, and, in company with 12 others, perished on the gallows.

AULIS, in ancient Greece, a seaport in Bœotia, on the strait called Euripus, between Bœotia and Eubœa, noted chiefly for its temple of Artemis, and as the scene of the sacrifice of Iphigenia, and as the gathering place of the Greek fleet before the Trojan War.

AULLAGAS, oul-lä'gas, a salt lake in Bolivia, which receives the surplus waters of Lake Titicaca through the Rio Desaguadero, and has only one perceptible, insignificant outlet. The disposition of its superfluous water is, therefore, still a matter of uncertainty.

AULNEAU DE LA TOUCHE, ôl'nō' de-la-toózh, **Jeanne Pierre,** Jesuit martyr: b. France 1705. In 1735 he was sent as missionary to the Indians at the Lake of the Woods. In the following year he set out with a party of Frenchmen for Mackinac, but the whole party was surprised and massacred by Sioux on the 8th of June at Massacre Island, Lake of the Woods.

AULULARIA (from *Aulula,* a pot), a comedy by Plautus. Euclion, an old miser, is the principal character.

AUMALE, ō-mal', **Henri Eugène Philippe Louis d'Orleans, Duke of,** 4th son of King Louis Philippe of France: b. Paris, 16 Jan. 1822; d. Zucco, Sicily, 7 May 1897. He entered the military service at the age of 17, and distinguished himself by his bravery. At the age of 20, he was promoted to the rank of brigadier-general, and was sent to Algeria, in October 1842. Entrusted with the command of the district of Medeah, he attacked the smala of Abd el Kader with such impetuosity that in less than two hours the emir's troops were entirely routed. As a reward, Aumale was made lieutenant-general and commander of the province of Constantine. In 1847, the young prince, but 25 years old, was entrusted with the general governorship of Algeria, which was taken from the hands of Marshal Bugeaud. This appointment was not approved either by the army or the French nation, and it was the occasion for loud complaints against the ambition of the King, who was concentrating the direction of the whole military service in the hands of his sons. After the revolution of 1848, he went to England, where he devoted his attention to literary pursuits. In 1870 he was refused permission to enter the French army, but in the following year he was elected to the Assembly from Oise and took his seat. In 1873 he was general of division and presided at the trial of Bazaine. In 1886 he was debarred from the army under the Expulsion Act and withdrew to England. He bequeathed the Château of Chantilly to the Institut de France. In 1889 the decree of banishment against him was revoked. His latest years were passed in Sicily. He wrote 'Les institutions militaires de la France' (1867); 'Histoire des Princes de Condé' (1869) and 'Lettre sur l'histoire de France' (1861), which attracted wide notice because of its attacks upon Napoleon III and the Prince Imperial.

AUMALE, ō'mal', France, a town 35 miles northeast of Rouen, which has given titles to several notables in French history: Jean d'Arcourt, 8th Count d'Aumale, fought at Agincourt, and defeated the English at Gravelle (1423). Claude II, Duc d'Aumale, one of the chief instigators of the Massacre of Saint Bartholomew, was killed 1573. Charles de Lorraine, Duc d'Aumale, was an ardent partisan of the League in the politico-religious French wars of the 16th century. Glass and steel are manufactured in the modern town.

Pop. (1911) 2,412. Consult Semichon, 'Histoire de la ville d'Aumale' (Paris 1862).

AUMONT, ō-mōn', the name of one of the great historical families of France. The first Aumont mentioned in history is JEAN III, SIRE D'AUMONT, who, in 1328, took part in the battle of Cassel, and served under Philip de Valois, on many other important occasions. A more distinguished member of the family was JEAN D'AUMONT: b. 1522; d. 1595. He was on the battlefield almost from his cradle to his grave, and served under six kings: Francis I, Henry II, Francis II, Charles IX, Henry III and Henry IV. ANTOINE D'AUMONT: b. 1601; d. 1669; served with distinction under Louis XIV, and in 1662 was appointed governor of Paris. LOUIS MARIE VICTOR D'AUMONT and DE ROCHE, BARON: b. 1632; d. 1704; took an active part in the war in Flanders under Louis XIV, was governor of Boulogne and the Boulonnois, and member of the Academy of Inscriptions and Belles-lettres. JACQUES, DUC D'AUMONT: b. 1732; d. 1799; was the commandant of the national guard, on 5 Oct. 1789, when Louis XVI was forcibly taken away from Versailles. LOUIS MARIE CÉLESTE DE VIENNE, DUC D'AUMONT: b. 1762; d. 1831; served in Germany, Spain and Sweden, until the restoration, when he was appointed lieutenant-general. He made himself very useful to the cause of royalty in suppressing the troubles in Normandy, and in 1815 was created peer of France, and raised to the office of first chamberlain. He was one of the most prominent men at the courts of Louis XVIII and Charles X, but he exchanged politics for theatres, and became the chief director of the comic opera.

AUNGERVILLE, ân'ger-vĭl, **Richard**, known as RICHARD DE BURY (from his birthplace, Bury Saint Edmunds), an English statesman, bibliographer and correspondent of Petrarch: b. 1281; d. 1345. He was educated at Oxford. He entered the order of Benedictine monks, and became tutor to the Prince of Wales, afterward Edward III. Promoted to several offices of dignity, he ultimately became bishop of Durham (1333) and Lord Chancellor of England. He made the acquaintance of many of the eminent men of the day, and was a diligent collector of books. He was the author of 'Philobiblon,' 'Epistolæ Familiarium,' including letters to Petrarch, etc. (See PHILOBIBLON). Consult Boardman, 'Richard de Bury' (Bangor 1902); Dutt, 'Bury St. Edmunds' (London 1907); Kitchin, 'Seven Sages of Durham' (ib. 1911).

AURA. See EPILEPSY.

AURAMINE. See COAL TAR COLORS.

AURANGABAD, ou-rŭn'gą-bäd', India, town 175 miles from Bombay, and on the Kuam River, a small tributary of the Godavery. It is surrounded by walls with semi-circular towers at the different angles, and contains a ruined palace of Aurungzebe and a mausoleum erected to the memory of his favorite wife. A mile to the west of the town are cantonments for cavalry, infantry and artillery. Aurangabad was founded early in the 17th century, and rose to be a considerable trading centre, but its commercial importance decreased when Hyderabad became the capital of the Nizam. In late years the trade has revived considerably, and embraces wheat, cotton and manufactured goods. Pop. about 25,000.

AURANTIA. See COAL TAR COLORS.

AURATES. See AURIC ACID.

AURAY, â'rā', France, town in the department of Morbihan, near the mouth of the Auray River, in Brittany, 12 miles west of Vannes. Its port is frequented by coasting and fishing vessels. Auray is one of the chief centres in France for oyster-breeding, and carries on boat-building and sardine-fishing. The principal buildings are the church of Saint Esprit, the Renaissance church of Saint Gildas and, at a short distance from the town, the Carthusian monastery, now a deaf and dumb institute. Adjoining it is a small chapel in which are preserved the bones of the Royalists captured by the Republicans in a battle here in 1795. In the neighborhood is the church of Sainte Anne d'Auray, one of the principal places of pilgrimage in Brittany. Pop. about 5,000.

AURBACHER, owr'bā-hĕr, **Ludwig**, German author: b. 1784; d. 1847; well remembered by his 'Volksbüchlein' (1827–29); a collection of popular tales, ranking among the best productions of this kind in German literature.

AURELIA. See JELLYFISH.

AURELIAN, Lucius Domitius Aurelianus, one of the later emperors of Rome: b. about 212; d. 275. He was the son of a peasant of Illyricum, and rose to the highest rank in the army, and even to the consulate; which good fortune was increased by a wealthy marriage. Claudius II, on his death-bed, in 270, recommended Aurelian to the choice of the troops of Illyricum, who readily acceded to his wishes. He delivered Italy from the barbarians, reduced Tetricus, who had been unwillingly made to assume the purple in Gaul, and conquered the famous Zenobia, Queen of Palmyra. Aurelian followed up his victories by the reformation of abuses, and the restoration throughout the empire of order and regularity, but tarnished his good intentions by the general severity of his measures, and the sacrifice of the senatorial order to his slightest suspicions. He had planned a great expedition against Persia, and was waiting in Thrace for an opportunity to cross the straits, when he lost his life by assassination, the result of a conspiracy excited by a secretary whom he intended to call to account for peculation. Aurelian was a wise, able and active prince, and well deserved the title given him by the Senate of "Restorer of the Roman Empire." Consult 'Cambridge Mediæval History' (Vol. I, New York 1911) and Homs, L., 'Le règne de l'empereur Aurelien' (1904).

AURELIAN, a historical novel by William Ware, an American author born in 1797. It was first published in 1838 under the title 'Probus,' and was a sequel to 'Letters of Lucius M. Piso,' published the year before; and like that novel, written in the form of letters. The full title is 'Aurelian; or, Rome in the Third Century. In Letters of Lucius M. Piso, from Rome, to Fausta, the daughter of Gracchus at Palmyra.' The novel presents a singularly faithful picture of the Rome of the second half of the 3d century.

AURELIAN WALL, a wall around Rome, built mostly by the Emperor Aurelian, but completed in the reign of Probus. It was almost 12 miles long, and 54 feet high, enclosing an area of 5,000 square miles, and marking the boundaries of Rome in the time of Aurelian. The wall was built in great haste as a defense against the barbarians, and includes the remains of house- and garden-walls, some with statues in their niches. A covered way near the base of the wall was provided with loopholes toward the outer side and arcade on the inner. Towers, 380 in number, connected this way with the battlements above. A large part of the wall is still well preserved. Much has been learned from the stamped bricks used in its construction, and from the statues and frescoes on the walls of houses filled in instead of being demolished in the hurry of building. Consult Lanciani, 'Ancient Rome' (New York 1900) and Platner, 'Topography and Monuments of Ancient Rome' (Boston 1911).

AURELIUS ANTONINUS, Marcus. See MARCUS AURELIUS ANTONINUS.

AURELIUS VICTOR, Sextus, Roman historian of the 4th century whose 'History of the Cæsars' is a collection of biographical sketches of the emperors from Augustus to Constantine. In this work he states that Julian appointed him governor of a division of the province of Pannonia and also that he was made city prefect by Theodosius. He is identified as the Aurelius Victor who with Valentinian was consul in 373 A.D.

AURELLE DE PALADINES, ō-rĕl-de-pȧ-lȧ-dēn', **Louis Jean Baptiste d',** French soldier: b. Malégieux, Lozère, 9 Jan. 1804; d. Versailles, 17 Dec. 1877. Entering the army in 1824, he served throughout the Algerian and Crimean campaigns, becoming a general of division in 1855. He did not participate in the Franco-Prussian War until after the battle of Sedan, when he received a command and drove the Prussian General Von der Tann-Rathsamhausen from Orleans, thus winning the first French victory of the war. His later operations were not so successful, however, as he was beaten by the army of the Grand Duke of Mecklenburg at Artenay, whereupon he was relieved of his command. During the days of the Commune he was in command of the National Guard in the department of the Seine. After the war, in 1875, he was elected to the French Senate for life. He is the author of 'Campagne de 1870–71; la première armée de la Loire' (1872).

AURENGZEBE, ȧ'rĕng-zēb'. See AURUNGZEBE.

AUREOLA, or **AUREOLE,** in paintings, an illumination surrounding a holy person, as Christ, a saint or a martyr, intended to represent a luminous cloud or haze emanating from him. It is generally of an oval shape, but may be nearly or quite circular, and differs from the nimbus surrounding the heads of sacred personages in being an emanation of light from the whole body. The aureole did not come into favor until after the 8th century and was abandoned by most painters of the Renaissance in the 15th century. It was used around figures of Christ, the Trinity and the Virgin Mary.

AUREOSIN. See COAL TAR COLORS.

AUREUS, ȧ'rę-ŭs, or **AUREUS NUMMUS,** the earliest gold coin of Rome, coined 207 B.C., in the second Punic War. It weighed 2 denarii, and 1 quinarius, and was worth 25 denarii, or 100 sesterces. In modern terms, its average weight was 121 grains and its value was about $500. In later times it was called *solidus,* but had diminished in value. Consult Hill, G. F., 'Handbook of Greek and Roman Coins' (London 1899).

AURIC ACID. Trioxide of gold, Au_2O_3, does not combine with acids to form salts, but a hydrated form of the oxide, $Au_2O_3.H_2O$, is known, which unites with bases to form salts. From this acid-like property, the hydrated oxide has been called "auric acid." Compounds of auric acid with bases are called "aurates." Aurate of potassium, $Au_2O_3.K_2O.3H_2O$, is a crystalline substance, readily dissolving in water with the formation of an alkaline solution. When digested with ammonium sulphate, it yields an aurate of ammonia of undetermined composition, called "fulminating gold." This substance, yellowish-brown in color when in the solid form, decomposes explosively upon percussion, or when heated to 212° F.

AURICH, ou'rih, Germany, town in the province of Hanover, 18 miles northwest of Emden. It has a palace, two churches, a gymnasium and four libraries. There are breweries and small manufactories of paper and tobacco. It is built in Dutch style, and lies in a sandy but fertile plain, surrounded by pleasant promenades which have taken the place of the old fortifications. Pop. about 6,000.

AURICHALCITE (-kăl'-), a native basic carbonate of copper and zinc, usually occurring in beautiful bright blue or green, pearly incrustations, composed of ill-defined crystals or scales. Its hardness is 2, and its specific gravity about 3.6. It has been found in Greece, Italy, England and various other European countries, and in fine specimens at Morenci in Arizona, Magdalena in New Mexico, in Colorado, Montana, Utah and elsewhere.

AURICLE. See EAR.

AURICLES OF THE HEART. See HEART; CIRCULATION.

AURICULA, a hardy perennial herb, *Primula auricula,* of the family *Primulaceæ,* found in the mountainous parts of central Europe. The wild plant has an umbel of small yellow flowers on a short stalk, which rises from a rosette of basal leaves. By selection a very large number of varieties have been produced. These have long stalks and very diversely colored, fragant, large flowers, for which the plant is widely cultivated in Europe. In the United States the plant is mostly confined to greenhouses. It is propagated by means of seeds and offsets, and succeeds best on rich, light, loamy soil.

AURICULAR CONFESSION. See CONFESSION; PENANCE; SACRAMENTS.

AURIFABER, the Latinized name of JOHANN GOLDSCHMIDT, one of Luther's friends: b. 1519; d. Erfurt 1579. He became pastor at Erfurt in 1566. He collected the unpublished manuscripts of Luther, and edited the 'Epistolæ' and the 'Table-Talk.'

AURIGA, in astronomy, the Wagoner, a constellation of the northern hemisphere, containing as its chief luminary Capella, a star of the first magnitude. In 1892 a new star was discovered in the foot of Auriga. At its brightest it showed as a star of the fourth magnitude and remained visible to the naked eye for about a month, afterward becoming rapidly invisible. After several months it again reached the tenth magnitude, but its spectrum had undergone a great change, having become assimilated to the nebular type. It has since resumed its stellar character and is of the thirteenth magnitude.

AURILLAC, ō're-yak', France, a town 272 miles south of Paris, capital of the department of Cantal (Auvergne), on the Jordanne. It is noted for its ancient buildings, among which are the church of Notre Dame, constructed in the 13th century, and the castle of Saint Stephen. It has manufactures of jewelry, copper, kettles, paper, woolen stuffs and carpets. It is said to owe its origin to a Benedictine monastery founded in the 9th century by Saint Géraud. The town was besieged several times by the English in the 14th and 15th centuries and it suffered in the religious wars of the following century. It is the birthplace of Pope Sylvester II and also of the infamous Carrier of the French Revolution. Pop. (1911) 18,036.

AURIN, or **AURINE**, $C_{19}H_{14}O_3$. A coloring substance used in the manufacture of lacquers. It is obtained by the action of sulphuric and oxalic acids on carbolic acid at 130°–150° C. It is little used as a dye because of the difficulty of fixing it. Its solution in alkali has a beautiful red color.

AURINGER, Obadiah Cyrus, American author and clergyman: b. 4 June 1849, at Glens Falls, N. Y. Educated in public schools and by private tutors, he contributed literature to papers and magazines of United States from the age of 18. Entered the United States Marine Corps June 1871; and served in the tropics on the flagship *Worcester* till August 1875. Engaged in agriculture for some years, studied theology and was ordained to the Presbyterian ministry in 1890. He served churches at Northwood, N. Y. (1890–93); Troy, N. Y. (1893–99); Forestport, N. Y., till 1912. He is the author of several volumes of verse, including 'Scythe and Sword' (1887), 'The Heart of the Golden Poem' (1890), 'Book of the Hills' (1896), 'Friendship's Crown of Verse,' 'The Lover's Tragedy' (1898), 'William McKinley Memorial' (1906), 'Eagle's Bride' (1911). In prose he has contributed a sketch of Edward Eggleston to 'Authors at Home' series; and numerous papers on American archæology to State publications. His latest work is an historical play 'Thistledown.'

AURISPA, ou-rē-spä, **Giovanni**, Italian scholar: b. Noto, Sicily, 1369; d. Ferrara 1460. He went to Constantinople in 1418 for the purpose of studying Greek. On his return some years later he brought with him many valuable manuscripts, among them some of the writings of Pindar, Sophocles, Plato and Callimachus. For a while he taught Greek literature at Bologna. After a short period as teacher in Florence he removed to Ferrara. In 1438 he was invited by the Emperor of Byzantium, John Palæologus to attend the council called by the Pope Eugene IV at Basel. The result was that he became the Pope's secretary, in 1441, and remained in this office for six years. Many of his translations are to be found in manuscript, in the libraries of Europe, but only the following have been published: Hierocles' 'Liber in Pythagoræ Aurea Carmina, Latinitate Donatus' (Padua 1474); 'Philisci Consolotoria' (Paris 1510). Consult Voight's 'Die Wiederbelebung des klassischen Alterthums' (Vol. I, Berlin 1893).

AUROCHS, ä'rŏks, the European bison (*Bosbonasus*, or *Bison europœus*) called by Germans "wisent" and in the Slavonic languages "subr" or "suber." This great bison stands six feet or more in height at the shoulder, and closely resembles the American bison or "buffalo" (q.v.); it is believed, indeed, that the American animal descended from the ancestral race of aurochs. When the Romans spread northward into Europe they found these and other oxen in the forests wherever they went, and even down in the days of Charlemagne they were spread over Germany and were beasts of chase. They have steadily diminished, however, until now they exist only as a single herd in the royal forest-preserves of Bielovege, in Lithuania, which in 1899 numbered 700 while a few hundred roam in the Caucasian Mountains. The name "aurochs" is also applied sometimes to the urus, the ancient wild ox of Europe (*Bos primigenius*), the supposed ancestor of our domestic cattle. See BISON.

AURORA, Ill., city, Kane County, on Fox River, and on the C., B. & Q., the C. & N. W., the E. J. & E., and the C. M. & G. railroads. Is the hub of electric interurban lines extending in all directions to Chicago, to Elgin and Dundee, to DeKalb, Yorkville, and Morris and Joliet. It was founded in 1834 by Joseph and Samuel McCarty; at first there were two incorporated villages, one on each side of the river, until 1840, they were made one municipality and organized as a city. Aurora is an important manufacturing city, having a variety of extensive establishments; these include the shops of the Chicago, Burlington & Quincy Railroad, cotton mills, wheeled scraper factory, railroad dump cars, racing sulky, paint, door hangers, chemical supplies, wrappers, shirts, corsets, steel cabinets and shelving, flour, mattresses, roofing, silverware, lithographing, cooperage, fertilizer, toilet articles, binder board, automatic tools, stoves and ranges, brick, brushes, typewriter supplies, conveying machinery, gravel plants, condensed milk, acetylene gas, woodworking machinery, pumps, motorcycles, grindstones, paper boxes, gas mantles, millwork, well machinery. There are several foundries and machine shops, and a large number of small manufactories. The United States census of manufactures for 1914 recorded 140 industrial establishments of factory grade, employing 5,497 persons, of whom 4,778 were wage earners, receiving $3,033,000 annually in wages. The aggregate capital employed was $14,806,000, and the year's output was valued at $10,789,000; of this, $5,530,000 was added by manufacture. There are five national banks and one State bank. The city has 43 churches, a good system of public schools, including two high schools, the East

High School and the West High School, and a public library, a building for which was presented by Andrew Carnegie. It is also the seat of the Advent Christian College, and of the Jennings Seminary for young women. There are fine buildings owned by the Y. M. C. A. and the Y. W. C. A., a city hospital and Saint Joseph and Saint Charles hospitals, and a new State armory. The government is vested in a mayor and city council of 14, seven of which are selected each year, for a term of two years. The water and electric lighting plants are owned and operated by the city. Aurora was the first city in the world to light its streets by electricity. Pop. (1900) 24,147; (1910) 29,807, an increase of 23.4 per cent; (1916) 36,000.

AURORA, Ind., a city in Dearborn County, on the Ohio River, C., C., C. & St. L. and the B. & O. S. W. railroads, 29 miles southwest of Cincinnati, Ohio, with which it has regular steamboat connection. There are extensive car and machine shops here, and manufactories of furniture, wheels, tools, barrels, buggies, coffins, brick and flour. It has also a large grain and hay trade. There is a public library and a fine public park. Aurora was settled in 1819 and chartered as a city in 1848. Pop. (1910) 4,410.

AURORA, Mo., city in Lawrence County, situated on the St. L. & S. F. and St. L., I. M. & S. railroads, 30 miles southwest of Springfield, 18 miles northeast of Pierce City. The chief industries are fruit growing, lead and zinc mining and farming. There are also flour mills, foundries and machine shops, marble works and a canning factory. Aurora has two banks with $75,000 capital. The city has adopted the commission form of government, and is supplied with water from dams in the White River. Pop. 4,148.

AURORA, Neb., city, county-seat of Hamilton County, on the Burlington and Missouri River Railroad, 105 miles southwest of Omaha. Though extensive brick yards and flour mills are operated in the town, it is mainly a stock raising and farming centre. The community owns its own waterworks. Pop. 2,630.

AURORA, N. Y., village in Cayuga County, situated on Cayuga Lake, 25 miles northwest of Ithaca, on the Lehigh Valley Railroad. It is the centre of an agricultural region, and is a residential town and favorite summer resort. It is the seat of Wells College for Women, the Wallcourt School for Girls and the Somes School for Boys. Aurora is two miles south of the site of the Jesuit mission to the Cayuga Indians, started in 1656, and was settled in 1789. The government is by town-meeting, held every two years to elect officers. Pop. (1910) 693.

AURORA (Greek, *Eōs*), in mythology, daughter of Hyperion and Theia, and sister of Helios and Selene. She is goddess of the dawn; rises from the ocean, drawn by the celestial horses, Lampus and Phæthon, and with rosy fingers raises the veil of night, shedding light upon the world. She was the wife of the Titan Astræus. Boreas, Notus, Hesperus and Zephyrus, and the other stars were her children. In art she appears as present at the death and burial of Memnon, as carrying away her favorites, as a goddess of light rising from the sea in a chariot with winged horses.

AURORA, a famous painting by Guido Reni, on the ceiling of the Casino Rospigliosi in Rome. Aurora precedes the sun god and strews flowers in his path. The fresco is remarkable for its coloring and is the painter's greatest work.

AURORA BOREALIS (French, *aurore boréale;* German, *Nordlicht*), the northern light. An illumination in the sky, seen oftenest north of middle latitudes in the northern hemisphere, and south of them in the southern hemisphere. In our hemisphere it is generally visible in the north, and has, therefore, been called the Aurora Borealis. In the southern hemisphere it is called the Aurora Australis.

The frequency with which it is seen varies with the latitude of the place. It is comparatively rare within 45° of the equator, but becomes more frequent toward the north up to the latitudes of about 60°, where it sometimes becomes almost a nightly occurrence. Nearer the pole it again becomes less frequent. We shall first describe it as it is commonly seen in our own latitudes. The first noticeable phenomenon commonly occurs after the end of twilight, when the northern sky near the horizon will be seen illuminated with a light somewhat like that of the dawn. Careful examination will show, however, that the illumination is in the form of a broad arch, highest near the magnetic north, and reaching the horizon in the northeast and northwest directions. Presently beams of light are seen crossing this arch with a quivering or flickering motion and shooting toward the zenith. Each beam constantly varies in brightness and seemingly fades away to give place to another.

In more northern latitudes, say north of 45° or 50°, these beams form the most brilliant feature of the aurora. Sometimes they are arranged in curved, wavy lines like the slats of a window shade flying in the wind, giving the appearance of a scroll in the process of being unrolled. In the case of a very brilliant aurora the beams may cover almost or quite the entire sky. In this case they will be seen to converge toward a point commonly not far from the zenith. The appearance presented by the beams grows out of the direction in which they are seen and from the laws of perspective. Long-repeated observations show that the rays are really parallel to the direction of the dipping needle, or to the lines of the earth's magnetic force. In the latitudes which we have mentioned, the dip is commonly more than 60°, increasing to 90° at the magnetic pole; hence when a great number of beams, all parallel to each other, are viewed from a point on the earth's surface under the region in which they are found, they all seem to converge according to the laws of perspective, toward that part of the sky to which the upper (south) pole of a dipping needle is directed. If the parallelism to the magnetic lines is exact, the direction of this point should be the same as that of the compass needle itself. It is still an open question where the parallelism is exact. Many observations seem to show a deviation of 10° or more, but the determina-

tion of the exact centre of convergence is difficult unless the rays are so numerous as to cover a large part of the sky, and it is not certain that the deviation may not be due to errors of estimation.

The Nature of the Auroral Light.— As a general, perhaps universal, rule, the rays or beams which we have described have a slightly yellowish tinge. When their light is analyzed with the spectroscope, many lines, in one case nearly 150, have been found in the spectrum. Of these the brightest and most constant is in the yellowish green part of the spectrum, having a wave length of 557. This line is characteristic of the aurora, and is almost certainly due to krypton. Several of the others have been identified with the lines of oxygen and of nitrogen, a result which might have been expected since it is practically certain that the aurora is due to an electrical discharge in or through our atmosphere.

The light of an aurora does not proceed wholly from the beams. Very irregular sheets of light, having the appearance of thin luminous clouds, are often seen. These are of various colors, red being especially frequent. The appearance is then that of a red cloud illuminated by the rays of the sun sometime after the latter has set. The light can, however, be easily distinguished from that of a cloud by its diffused character and the absence of any definite outline. The height of the region in which the auroras are formed has never been definitely determined. The most important question is, whether the height is, in any case, above the upper limit of the atmosphere. This question is all the more difficult in that this limit is in itself an uncertain quantity. Observations of shooting stars show that these objects become visible at a height of about 100 miles above the earth's surface. The limit of the atmosphere must therefore be as high as this, and may be much higher. The difficulty of making observations upon the same auroral beams, at one moment, at different points of the region from which they are visible, is such that no exact determination of the height of a beam has ever been made. There is some reason to believe that the height may sometimes range from 100 to 150 miles, but there is no reason to believe that a beam is ever seen above the possible limit of the atmosphere. It might be supposed that by laying off a suitable base line on the earth, from the extremities of which the altitudes of selected portions of the light are measured, the heights might be determined in a very simple manner, and indeed in the older meteorologies results of observations made in this way are frequently stated. But it is now regarded as certain that such figures can claim but little accuracy. If the base is a long one, as is necessary in measuring the greater heights, it is very uncertain whether the two observers are measuring to the same region of illumination, beside which the very rapid motions of such regions in auroral display introduce a further element of uncertainty.

The lower limit of the aurora cannot be said to have yet been accurately determined but it is probable that this must in some cases be placed within a mile or two of the earth's surface, if, indeed, it does not sometimes extend almost to the ground itself. Trustworthy observers have in some cases seen the beams between their own positions and a nearby mountain, or below the clouds, while careful measurements of the heights of low lying auroras have been secured. It is also very frequently observed in countries where auroras are numerous that the phenomenon is accompanied by a crackling sound, somewhat resembling the rustling of silk or straw, or the electrical sputterings accompanying wireless messages. Such sounds have been described in the Arctic regions as regularly increasing and decreasing in intensity as the brightness of the aurora waxed and waned. In such cases the aurora must have been very near the ground; it is not to be expected that any sound can be detected in lower latitudes, where the aurora occurs at a far greater altitude.

Cause of the Aurora.— Science has not been able to determine as yet with certainty and precision the cause of this very common phenomenon. When the luminous effect produced by the passage of electricity through the highly rarefied air of a vacuum tube was first observed, its resemblance to the aurora led to the view that the latter was produced by electric currents in the upper regions of the atmosphere. Although it is not impossible that such currents may be associated with the aurora, they do not adequately explain its light, and are apparently inadequate to explain its rays. Yet there is no doubt that the aurora is associated in some way with the magnetism of the earth. The coincidence of the rays of the aurora with the direction of the magnetic needle is one proof of this relation; another proof is found in the relation of the aurora to magnetic storms. The general rule is, that a very brilliant aurora is associated with such a storm, disturbing the magnetic needle not only at the point where the aurora is visible, but perhaps over the whole earth. Earth currents so strong that from time to time a line of telegraph may be run by them are also occasional accompaniments of a brilliant aurora, but although the intimate connection of the two phenomena is so well established, the exact relationship is yet to be worked out. In recent years Arrhenius has propounded a theory, based on the very probable fact that the sun emits a flood of corpuscles of a nature similar to that of the mysterious rays known as X-rays, cathode rays, electrons, etc., the investigation of which has occupied so large a place in recent physics. His theory is, that these corpuscles on approaching the earth are acted on in the direction of the lines of its magnetic force round which they describe helices. While nothing as yet has been found to disprove this theory, it is one which still needs much proving. What can be said with reasonable probability is that the aurora is caused by irregular emanations of corpuscles from the sun, which are stopped in the upper regions of our atmosphere.

Periodicity of the Aurora.— Records of auroras extending back two centuries or more show that they have been much more numerous at some periods than at others. Sometimes it has been supposed that they have been more numerous at intervals of 33 or some fixed number of years, but this has not yet been proved, nor has any law been determined by which we can definitely say at what times they appear in the greatest number. But several

periods are observed which show that the appearance of the aurora is in some way connected with the sun. The first instance of this is the fact that they are more numerous when the spots of the sun are more numerous. As there is an 11-year period in the spots on the sun, so there is a corresponding period in the aurora. There is also a semi-annual period in the frequency of the aurora, the greatest number being observed in March and September and the smallest in June and December. Arrhenius has connected this with the fact that in March and September the earth is over the region of the sun's surface in which spots are more numerous. Statistics also show that there are more auroras in the northern hemisphere when the moon is south of the equator than when she is north. This, however, is not proved to be a general law. There is also an observed period of 25.93 days in the frequency of the aurora. This is so near the time of the sun's rotation that it may be connected with the latter. Consult Angot, 'The Aurora' (*International Scientific Series*).

SIMON NEWCOMB.

Revised by ERIC DOOLITTLE, *Director Flower Astronomical Observatory.*

AURORA LEIGH. 'Aurora Leigh,' a narrative poem or "novel," as Mrs. Browning herself termed it, was begun in Italy, and completed in London in 1856. This romantic autobiography in blank verse tells, in nine books, the story of its half-English, half-Italian heroine; of her struggles to live by and for her art; and of the final triumph of her love for her cousin, the reformer Romney Leigh.

As a novel, 'Aurora Leigh' was immediately and enormously popular. But the poem holds other appeals to modern readers. Those who find its action undramatic, its characters unconvincing, its scenes unreal, its style too often that of rhetoric, not of poetry, will still turn to it as an inexhaustible mirror of its age. For in it lives mid-Victorian England: its complacent wealth and appalling poverty; its ladies of fashion and its prostitutes; its Fourierists and its Christian Socialists. It is in depicting the failure of Romney's reforms that Mrs. Browning voices the conviction that gives the poem its theme:

> "'Tis impossible
> To get at men excepting through their souls.
> And poets get directlier at the soul
> Than any of your economists."

And some readers will prize 'Aurora Leigh' as the record of the heart and mind of Elizabeth Barrett Browning: her keen satire on the English social order; her fearless sympathy with its victims; her recognition of the poet as the true interpreter of modern life; her exaltation of the creative power of love. Such readers will find in 'Aurora Leigh,' the poem into which Mrs. Browning's "highest convictions upon Life and Art have entered," the record of a woman greater than her poem. For full bibliography, see 'The Cambridge History of English Literature' (Vol. XIII, Ch. 3). Consult also Montégut, Émile, 'Ecrivains modernes de l'Angleterre' (Deuxième série, Paris 1889); Texte, Joseph, 'Études de littérature européenne' (Paris 1898).

FRANCES WENTWORTH CUTLER.

AURUNGZEBE, â'rŭng-zēb', the last important emperor of Hindustan, of the Mogul dynasty: b. 22 Oct. 1618; d. Ahmednuggur, 21 Feb. 1707. He was the son of Shah Jehan, and properly named Mohammed, but received from his grandfather that of Aurungzebe (Ornament of the Throne), by which he is known to history. Aurungzebe, in 1658, was crowned sole monarch of the great Mogul empire. Consult Stanley Lane-Poole, 'Aurungzib' (London 1893); Sarkan, T. N., 'Anecdotes of Aurangzib' (ib. 1812); id., 'History of Aurangzib' (ib. 1913).

AUS DEM LEBEN EINES TAUGENICHTS (1826) ("Out of the Life of a Good-for-Nothing"), by Josef Freiherr von Eichendorff is one of the most pleasing products of German romanticism, a story of perennial charm. The hero, whose name, oddly enough, is never disclosed, listens dreamily to the melody of his father's mill-wheel, but he hears rather the call of the open road, and with naive recklessness he simply wanders forth from the humdrum and the every-day on a quest for the unknown, his only luggage being his violin. The story is the record of his diverting and highly romantic adventures. His attitude as a traveler may well be described in the words of another wanderer with whom he journeys for a time: "When we start out in the morning, the finest thing about it is that we have no idea what chimney is smoking for us that day, or what good fortune may be ours before nightfall." But, unlike various other stories of romantic wandering, Tieck's 'Franz Sternbalds Wanderungen,' for example, Eichendorff's tale has a genuine plot upon which a substantial part of the interest depends. As a late product of the romantic era, the story lacks the earlier vagueness, mysticism or morbidity of the school; it is an unsurpassed example of romantic "Wanderlust," and it illustrates as well the characteristic turning of northern eyes toward the colorful lands of the south, for the hero seeks the road to Italy and finds it. Eichendorff's talent was essentially lyric, and his little story is flooded with lyric feeling; in it, indeed, several of his most charming lyrics are embedded; for example: Wem Gott will rechte Gunst erweisen, den schickt er in die weite Welt ("When God a special favor granteth, He sends one roaming through the world", or, Wer in die Fremde will wandern ("Who in distant lands would wander"). Consult trans. by C. G. Leland, 'Memoirs of a Good-for-Nothing' (New York 1866), and by Mrs. A. L. Wister, 'Leaves from the Life of a Good-for-Nothing' (Philadelphia 1889).

HARVEY W. THAYER.

AUSABLE (ō-sāb'l) **CHASM,** a picturesque and popular American summer resort, in New York State, 12 miles from Plattsburg and one mile from Keeseville. It is an isolated formation, wholly independent of, and disconnected from, any other similar panorama. At the beginning of the chasm, the river is hemmed into a channel not more than 10 feet wide by walls of rock from 100 to 200 feet high. Lower down the walls gradually spread apart till in some places there is a distance between them of 50 feet, and then extend with sharp turns and occasional enlargements for nearly two miles. Lateral fissures, narrow and deep, pro-

ject from the main ravine at nearly right angles, and through one of these a staircase of over 200 feet reaches to the abyss. The walls are formed of laminæ of sandstone, laid in precise and regular order, and their crevices are filled with a thick growth of hardy pines and cedars. The trip through the chasm may be made in a small boat or on foot. For the accommodation of tourists, stone walks with substantial iron railings and firm bridges have been constructed.

AUSCULTATION, a method of examining the body by means of the sounds given to the ear. The naked ear may be used, or instruments, such as the stethoscope (q.v.), or the phoneidoscope, be employed. The natural sounds may be alone investigated, as in listening to the breathing sounds, or the heart sounds, or the organ, or that portion contiguous or remote from the organs, may be tapped, or percussed, to determine variations in the resonance. All of the parts of the body may be investigated by these means. Auscultation is probably, next to inspection, the oldest mode of investigation. Hippocrates II used it extensively, but it was not until Lænnec, in 1816, gave his demonstrations that the method came to be recognized as one of the most important in the diagnosis of diseased conditions. Early views had it that the sounds produced were capable of directly revealing the nature of disease and Skoda first demonstrated that they were only manifestations of peculiar physical states of the body. Consult Butler, 'Diagnostics of Internal Medicine' (1901); Cabot, 'Physical Diagnosis' (New York 1912); Le Fevre, 'Physical Diagnosis' (ib. 1905); Sahli, 'Untersuchungsmethoden.' See PERCUSSION.

AUSGLEICH (ous'-glīh) **OF 1867, The,** a compact by which was created the present close union between Austria and Hungary; the Austro-Hungarian monarchy. According to the provisions of this document, the two monarchies have, first of all, a common ruler, the emperor of Austria being also the Apostolic King of Hungary. He is crowned both at Vienna and Buda-Pesth. Aside from that, the agreement extends to a common administration for certain matters of state; a customs union, a joint commercial policy, a uniform system of coinage and weights and measures, as well as a joint control of industrial monopolies and the railways. In foreign affairs the two nations have only one policy, as well as one financial policy. In military organization they are practically one state. Each nation has an independent Parliament, but the two ministries are controlled by a third body, a joint Parliament, known as the Delegations. This body is made up of representatives of both governments, each delegation numbering 60 members, elected by their respective Parliaments. They meet alternately each year in Vienna and Buda-Pesth, though much of their business is carried on by correspondence. The various provisions of the Ausgleich are renewable every 10 years. In 1897 the agreement regarding the customs union failed of renewal, and was later replaced by a reciprocity treaty. The last general renewal was in 1907.

AUSONIA, a poetical synonym for Italy; so used by Virgil and other Roman poets.

AUSONIUS DECIMUS MAGNUS, the most distinguished Roman poet of the 4th century A.D.: b. Burdigala (Bordeaux) about 310; d. about 392. He studied under several distinguished masters, and became at last professor of rhetoric in his native city, whence his fame extended through the whole empire. Valentinian entrusted to him the education of his son, Gratian, and appointed him afterward quæstor and prætorian prefect. After Gratian had ascended the throne he showed himself not less grateful to his preceptor. About the year 379 he appointed him consul in Gaul. After the death of Gratian, Ausonius lived upon an estate at Bordeaux, devoted to literary pursuits. As Valentinian was of the Christian religion, it is probable that Ausonius was so, too; and many of his writings confirm this conjecture. Critics are not unanimous on the subject of his poetical merits. He is undeniably learned and ingenious, but his style and versification have the blemishes of the age, and his Latin is impure. His epigrams, idyls, eclogues, letters in verse, etc., are extant. The best edition is that of 'Peiper' (Leipzig 1886). Consult Delachaux, A., 'La latinité d'Ausone' (Lausanne 1909); Dill, 'Roman Society' (London 1899); Mackail, 'Latin Literature' (New York 1896).

AUSPERG, Karlos, Prince. Austrian statesman: b. 1 May 1814; d. 1890. After a long service in the army he became a member of the upper chamber of the Austrian Reichsrath. Later he became president of the Austrian House of Peers, where he used all his influence against the Clericals. In 1868 he presided over the ministry and strongly supported the Liberal Cabinet, at the head of which was his younger brother Adolf.

AUSPICES. See AUGURIES AND AUSPICES.

AUSTEN, Jane, English novelist: b. Steventon, Hampshire, 16 Dec. 1775; d. Winchester, 18 July 1817. Miss Austen was the daughter of the Rev. George Austen, rector of Steventon and Deane, and Cassandra Leigh Austen, daughter of the Rev. Thomas Leigh and niece of Theophilus Leigh, for many years master of Balliol College, Oxford. Jane was the youngest of seven children, of whom others besides herself, particularly Admiral Francis William Austen, became distinguished. Until 1801 she lived at Steventon. Her life here was quiet, domestic and moderately studious. Much of her spare time she spent in writing, chiefly for her own amusement. In 1801 the family removed to Bath, whence Miss Austen made visits to Lyme, Southampton and other places in the south of England. Her father died in 1805, and in 1809 she settled at Chawton, in Hampshire, where she remained until within two months of her death. In May 1817, after some months of ailing health, she went to Winchester for treatment, and there died in the following July.

Miss Austen began writing stories at an early age, and before 16 is said to have composed good-humored nonsense. The first of her extant novels, 'Pride and Prejudice,' was written between October 1796 and August 1797. Before that she had written 'Eleanor and Marianne,' which, in 1797–98, she altered into the present 'Sense and Sensibility.' Her third novel, 'Northanger Abbey,' belongs to 1798. The first of these novels to be published was

'Sense and Sensibility,' in 1811. Two years later 'Pride and Prejudice,' which had been refused by a publisher in her father's lifetime, made its appearance. 'Northanger Abbey' had an even longer period of darkness; in 1803 it had been sold to a publisher for £10, but the publisher, after keeping it 10 years or more, sold it back to the family, by whom it was issued in 1818, the year after the author's death. In 1804, Miss Austen began 'The Watsons,' but never finished it, and until 1811 apparently did comparatively little writing. Between that year and 1816, however, she wrote 'Mansfield Park,' 'Emma' and 'Persuasion,' published respectively in 1814, 1816 and 1818. There is also an unfinished story, 'Lady Susan.'

The novels were not especially popular in the author's lifetime, though Scott and Macaulay (a little later) paid sincere and high tribute to their excellence. To-day they are regarded as among the best novels in the language and are probably as widely read as those of any first-rate woman novelist in English. The reason for their high place appears to lie in Miss Austen's skill as a story-teller and a drawer of character. The people she deals with are chiefly from the higher middle classes in the English country, and she rarely goes above or below them. In a time, that of the Napoleonic wars, when there was every temptation to write battle stories and heroics, Miss Austen kept her eye on the life that she knew, and had nothing to do with spectacular means of arousing interest. The aspect of the few warriors and seamen who come into her pages is domestic rather than martial. Nor is there any very serious adventure of any sort; the worst that happens is an elopement, or when a heroine slips down stairs and is stunned. Her people are quite unintellectual and in no wise grand or heroic. On the whole, her material is less startling than that of any English novelist, but the picture which she gives is unsurpassed in the perfection of truth, humor and vivacity. As a story-teller, she has, in point of technical construction, no superior. Her plots are not elaborate and there is no conspicuous wealth of invention; in all her six novels the plot turns on an elopement or a hidden engagement; but, granting this, the construction of 'Pride and Prejudice,' 'Emma' and 'Mansfield Park' is not to be bettered. They are models of their class of story telling. As an artist in character drawing, Miss Austen has contributed to the gallery of familiar persons such figures as Miss Bates, Mr. Woodhouse, Mrs. Bennet, Mrs. Norris and a number of others, all of whom are brilliant, though occasionally exaggerated, creations. All her important characters are strongly individual, and are so firmly drawn that there is no tendency to confuse them as types or as persons.

'Pride and Prejudice' is usually regarded as the best of the novels in point of liveliness of style, neatness of structure and vigor of substance. This position would be disputed by admirers of the more intricate 'Emma' and the more intricate and gloomy 'Mansfield Park,' both of which probably surpass 'Pride and Prejudice' in maturity and variety of characterization. 'Northanger Abbey' is less ambitious than either of the preceding; it is a very vivacious burlesque, with a charming moral. The other two novels, 'Sense and Sensibility' and 'Persuasion,' are usually thought to be inferior. See PRIDE AND PREJUDICE; ARROW MAKER, THE; EMMA; MANSFIELD PARK.

Bibliography.— Excellent editions of the novels of Jane Austen are easily to be had. The principal life is the Rev. J. E. Austen Leigh's 'Memoir of Jane Austen' (London 1870). There is also a life by Goldwin Smith in the 'Great Writers' series (New York 1890). The place of Jane Austen in literature is treated in such literary histories as Mrs. Oliphant's 'Literary History of the 19th Century' and W. L. Cross's 'The Development of the English Novel.' W. D. Howells, in 'The Heroines of English Novels' (1901) and 'Criticism and Fiction' (1891) pays very high tribute to Miss Austen as an artist and as a creator of character. Recent works are Constance Hill's 'Jane Austen: Her Home and Her Friends' (New York 1902); Mitton, G. E., 'Jane Austen and Her Times' (London 1905); Austen-Leigh, 'Jane Austen: Her Life and Letters: A Family Record' (New York 1913) and Cornish, in 'English Men of Letter Series' (New York 1913).

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AUSTEN, Peter Townsend, American chemist: b. Clifton, S. I., N. Y., 10 Sept. 1852; d. 1907. He was educated at Columbia University, School of Mines, and in Germany and Switzerland. In 1876, he was appointed instructor of chemistry at Dartmouth; in 1877, professor of chemistry at Rutgers. From 1887 to 1893 he was engaged in industrial work, and 1893–98 was professor of chemistry at Brooklyn Polytechnic Institute. He invented several useful manufacturing processes; wrote a number of valuable papers, and translated Pinner's 'Repetitorium der organischen Chemie' under the title 'An Introduction to the Study of Organic Chemistry,' and published the volume 'Kurze Einleitung zu den Nitro-Verbindungen' (Leipzig 1876).

AUSTERLITZ, ous'ter-lets, **Moravia,** a town on the Littawa, 13 miles southeast of Brünn. In the vicinity, on 2 Dec. 1805, was fought the famous battle between the French army of 80,000 men, commanded by Napoleon, and the combined Russian and Austrian armies, numbering 84,000, under their respective emperors; in which the former achieved a signal victory. According to Alison, the allies lost 30,000 in killed, wounded and prisoners, and the French, 12,000. The battle was followed by an armistice, the terms of which were dictated by Napoleon; and immediately after, on 26 December, by the Treaty of Presburg, which disastrously affected Austria. The battle of Austerlitz is sometimes called "The Battle of the Three Emperors." The present town has a population of about 4,000.

AUSTERLITZ, The Sun of, a term given to any favorable omen, in allusion to the brilliant appearance of the sun just before the battle of Austerlitz, and which Napoleon accepted as a token of coming victory.

AUSTIN, Saint. See AUGUSTINE, SAINT.

AUSTIN, Alfred, poet laureate of England, critic and journalist: b. Headingly, near Leeds, 30 May 1835; d. Kent, 2 June 1913. He

From the Hollyer photograph after Linnel

JANE AUSTEN

was the son of a wool merchant, educated at Stoneyhurst, Oscott and London University; called to the bar in 1857. After his father's death he abandoned the law and devoted himself to study and travel, and in 1864 he published his first success, 'The Season; a Satire,' after Byron. He had, however, written volumes of verse earlier. He ran for Parliament in 1865, but was defeated. In 1867 he joined the staff of the *Standard*, at that time one of the most influential London dailies, which ceased publication 16 March 1916. For this paper he wrote many «leaders,» reviews and biographies, and so stamped his personality and opinions upon that journal that it was humorously called «The Daily Alfred Austin.» Sent abroad, he did good work as special correspondent at the Vatican Council, the Prussian headquarters in the Franco-German War (1870), and the Berlin Congress (1878). He was editor of the *National Review*, 1883–93. His appointment as poet laureate in succession to Lord Tennyson, but nearly four years after the latter's death, was the cause of much surprise and comment. It was known that Swinburne, Browning and William Morris — his greatest contemporaries — were out of the running owing to their pronounced radical tendencies, and his chief competitors were Lewis Morris and Sir Edwin Arnold. Austin could by no stretch of imagination be called a great poet; yet he performed his official work satisfactorily, though both his poetry and his criticism were decidedly conservative and conventional. Perhaps his most attractive work was done in his pleasant books of garden life, of which 'In Veronica's Garden' was the most conspicuous. Some of his other works are 'The Human Tragedy' (1862); 'The Golden Age: a Satire' (1871); 'The Tower of Babel,' a drama (1874); 'Savonarola,' a tragedy (1881); 'The Garden that I Love'; 'In Lamia's Winter Quarters'; 'Haunts of Ancient Peace' (1902); and 'A Lesson in Harmony' (1904). In December 1899, he published a war poem, 'To Arms'! and in May 1900, one on the relief of Mafeking. In 1865 Austin married Miss Hester Mulock, who survived him, but left no children. His successor in the poet laureateship is Mr. Robert Bridges (q.v.).

AUSTIN, George Lowell, American physician and writer: b. Massachusetts 1849; d. 1893. Among his numerous works are 'Perils of American Women'; 'Water-Analysis' (1882); 'Under the Tide'; 'Life of Franz Schubert'; 'Popular History of Massachusetts'; 'Life of Wendell Phillips' (1888).

AUSTIN, Henry, American lawyer and legal writer: b. Boston, Mass., 21 Dec. 1858. He has been a commissioner of insolvency for six years and is an associate justice of the municipal court of Boston (West Roxbury district). He is the author of 'American Farm and Game Laws'; 'American Fish and Game Laws'; 'Liquor Law in New England.'

AUSTIN, Jane (Goodwin), American novelist: b. Worcester, Mass., 25 Feb. 1831; d. Boston, 30 March 1894. Her works include 'Fairy Dreams' (1860); 'Moonfolk' (1874); 'Mrs. Beauchamp Brown' (1880); 'A Nameless Nobleman' (1881); 'The Desmond Hundred' (1882); 'Nantucket Scraps' (1882); 'Standish of Standish' (1889); 'Betty Alden' (1891); and 'David Alden's Daughter and Other Stories' (1892).

AUSTIN, John, the most distinguished of English writers on jurisprudence: b. Creeling Mill, Suffolk, 3 March 1790; d. Weybridge, Surrey, 1 Dec. 1859. He entered the army in 1806 and served as a subaltern in Sicily and elsewhere until 1811, when he resigned his commission, returned to London, and took up the study of law. In 1818 he was called to the bar, and in 1820 married Miss Sarah Taylor of Norwich, a talented woman, to whose devotion and purpose Austin's success is in great part due. He removed to Westminster, where he became the intimate of some of the greatest minds of England, among others, of Jeremy Bentham and John Stuart Mill. His weak constitution coupled with a lack of courage hindered his success at the bar despite his great natural gifts and adequate legal knowledge. He retired from practice in 1825 and in the following year was appointed to the chair of jurisprudence in the newly-founded University of London. Jurisprudence had not yet received its due share of scientific study and as a science was neglected; hence Austin's efforts in this direction received scant recognition and his work may be classed a failure. The better to qualify himself for his task he spent some time at Bonn in reading and study under Niebuhr, Brandis, Arndt, Welcker and others who at that time made Bonn the chief seat of juristic learning in Europe. Austin returned to his classroom early in 1828 but his earnestness coupled with his precise and accurate definitions and classifications evoked scant enthusiasm among his students, whose number gradually dwindled until in 1832 he was obliged to resign his post. In this same year he published 'The Province of Jurisprudence Determined,' a work that placed its author in the foremost rank of writers on this subject. It was little appreciated by the public, however, and Austin was not encouraged to undertake other works of the kind. In the course of the following years he served on several royal commissions, one of which in 1836 took him to Malta. But here his health broke down, and on returning to England he was ordered abroad by his physicians. He remained on the continent until the troubles of 1848 in Europe drove him back to England, where he settled at Weybridge, residing there until his death. His widow issued a second edition of 'The Province of Jurisprudence' in 1861, and in her introductions gives a pathetic account of Austin's life struggle. In 1863 she collected and arranged for publication his lectures on the principles of jurisprudence, which were issued under the title 'Lectures on Jurisprudence, Being the Sequel to The Province of Jurisprudence Determined.' Austin's fame rests on these lectures, which are remarkable for the clearness and penetration of their analysis of legal conceptions. Austin is the first systematic writer on law in the English language. His work revolutionized the science of jurisprudence and exerted a wide influence on the legal thought of the last half of the 19th century. In the 20th century this influence appears to be on the wane owing to the larger conception of human society now possible and the historical spirit which has so moulded the thought of our day. For a defense

of Austin's theories consult Holland, Thomas E., 'Elements of Jurisprudence' (1900) and Brown, W. Jethro, 'The Austinian Theory of Law' (Boston 1910). For the opposite view consult the works of Sir Henry S. Main, especially 'Early Law and Custom' (London 1883); and 'Early History of Institutions' (ib. 1875). Consult also Mill, John Stuart 'Dissertations and Discussions' (4 vols., London 1875). See JURISPRUDENCE; LAW.

AUSTIN, Jonathan Loring, secretary and treasurer of Massachusetts: b. Boston, 2 Jan. 1748; d. 10 May 1826. He was graduated at Harvard in 1766, engaged in trade at Portsmouth, N. H., and in 1775 entered the army. For a time he was secretary of the Massachusetts Board of War and in 1777 was sent to Paris to announce to Franklin Burgoyne's surrender at Saratoga. He remained two years in Paris as Dr. Franklin's secretary. He also spent some time in England as agent of Dr. Franklin. On his return in May 1779, he was liberally rewarded by Congress. In 1780, in his passage to Spain as agent of the State, he was taken and carried to England. He afterward held the offices of State secretary and treasurer in Massachusetts, and died universally respected. His son, JAMES TRECOTHIC: b. Boston, 7 Jan. 1784, studied law, rose in the profession, and was attorney-general of the State from 1832 to 1843.

AUSTIN, Mary Hunter, American author and playwright: b. Carlinville, Ill., 9 Sept. 1868. She was graduated from Blackburn University, after which she spent 17 years in acquainting herself with the life of the Indians in the Mohave Desert. This experience has furnished her the material for most of her works, which are 'The Land of Little Rain' (1903); 'The Basket Woman' (1904); 'Isidro' (1905); 'The Flock' (1906); 'Santa Lucia' (1908); 'Lost Borders' (1909); 'Christ in Italy' (1912); 'The Lovely Lady' (1913). In 1911 she had produced a play, 'The Arrowmaker,' at the New Theatre, in New York city; 'Fire,' a drama; 'Love and the Soul-Maker' (1914); 'The Man Jesus' (1915).

AUSTIN, Moses, an American who obtained the first grant from the Mexican government for the formation of an American colony in Texas: b. Durham, Conn.; d. January 1821. He forwarded to the commandant-general at Monterey an application for permission to colonize 300 families in some part of Texas. The application was successful, and the enterprise prosecuted by his son, Stephen F. Austin (q.v.).

AUSTIN, Oscar Phelps, American statistician: b. Illinois. At the age of 12 he removed with his parents to Nebraska, where he remained until manhood. Engaged in journalism in Chicago and Cincinnati and Washington, serving as correspondent for newspapers in New York, Chicago and other cities. Appointed Chief of Bureau of Statistics, United States Treasury Department in 1898; resigned 1914 and became statistician of foreign trade department of the National Bank of New York. He is the author of 'Uncle Sam's Secrets'; 'Uncle Sam's Soldiers', and other publications for the instruction of youth in national and international affairs; 'Economics of World Trade'; 'Territorial Expansion of the United States'; also of official monographs 'Commercial China'; 'Commercial Japan'; 'Commercial Africa'; 'Russia and the Trans-Siberian Railway'; 'American Commerce'; 'Commercial Alaska'; 'Submarine and Land Telegraphs of the World'; 'Colonies of the World and Their Government'; 'Colonial Administration'; etc. He is secretary of the National Geographic Society; was lecturer on international trade and commercial geography in the George Washington University, 1904 to 1914, and before trade bodies in many cities; honorary degree M.A. from George Washington University; visited 20 principal countries in commercial studies.

AUSTIN, Sarah Taylor, English writer, wife of John Austin: b. Norwich 1793; d. London, August 1867. She was a member of a family distinguished for its literary and scientific attainments. She spent a long period of travel abroad, mainly in Germany, where she attained a wide knowledge of the German language and literature. Most of her works are translations from the German, the first of which was 'The Travels of a German Prince in England' (London 1832). Then followed 'Characteristics of Goethe,' by Falk (1833); 'The Story Without an End,' by Carové (1834); and 'History of the Popes,' by Ranke (1840). Among her original works are 'Considerations on National Education' (1839); 'Letters on Girls' Schools' (1857). Her daughter Lucie married Sir Alexander Duff-Gordon.

AUSTIN, Stephen Fuller, American pioneer: b. Wythe Co., Va., 1792; d. 27 Dec. 1836. He was a son of Moses Austin. He followed up the grant for a colony in Texas previously issued to his father. By it he was clothed with almost absolute power over the colonists, and only obliged to report to the captain-general. He founded what is now the city of Austin, the capital of Texas. The colony prospered, and, being accompanied by a considerable number of similar associations, promoted an influx of Americans to such an extent that they met 1 March 1833, without the concurrence of the Mexican population, in a convention to form a constitution for the as yet Mexican state of Texas. Austin was one of the delegates chosen to carry the result of their deliberations to the central government at Mexico, and obtain its ratification. The delays and frequent revolutions at Mexico leading him to despair of ever bringing his commission to a close, he addressed a letter, 2 Oct. 1833, to the municipality of Bexar, and through them to the people of Texas, recommending a union of all the municipalities to provide against the consequences of a probable refusal of their applications by organizing a state under the *Acta constitutiva* of 7 May 1824. This letter was considered treasonable, and Austin was arrested and held as a hostage for the good behavior of Texas. There he was detained until September 1835. He was appointed a commissioner to the United States in November 1835. This was before the Texan declaration of independence; and it was not till after his arrival at New Orleans, and the information of the union of Santa Anna with the federal party for the invasion of Texas, that he was brought to the point of recom-

mending such a measure. He acted with prudence and patience, and was successful in preparing for the independence and annexation of the new republic. He was a candidate for the presidency, but was defeated by Samuel Houston, who appointed Austin his Secretary of State. The latter, however, died suddenly on 27 December of the same year. He is looked upon as one of the most eminent and honorable of the founders of Texan prosperity. Consult Wooten, 'History of Texas' (2 vols., Dallas 1899); and Yoakum, 'History of Texas' (New York 1856).

AUSTIN, William, American author: b. Massachusetts 1778; d. 1841; remembered for his striking and original tale, 'Peter Rugg, the Missing Man,' in effect a New England variant of the Wandering Jew legend. Other works were 'Letters from London' (1804); 'An Essay on the Human Character of Jesus Christ' (1807). Consult 'Literary Papers of William Austin,' with biographical sketch (Boston 1870).

AUSTIN, Minn., city and county-seat of Mower County, situated on Red Cedar River, and on the Chicago G. W. and the Chicago, M. & St. P. railroads, 100 miles south of Saint Paul. It is the centre of a fertile agricultural region, producing live stock, corn, barley, flax and grass seeds, and has a large export trade, as well as a variety of manufacturing establishments including a meat-packing factory, flour mills, cement works, railroad shops, brick and tile works, creamery, foundry, machine and steel works, roller mills, broom and brush factories, etc. It is the seat of the Southern Minnesota Normal College, and has several fine public buildings, among them a Carnegie library, county courthouse, State armory, post-office, central high school, and Saint Augustine's Roman Catholic Church and Methodist Episcopal Church. Austin was first settled in 1854, incorporated as a village in 1868 and chartered as a city in 1873. The present government, vested in a mayor, elected biennially, and a city council, is under a charter adopted in 1903. The waterworks and electric-light plant are owned by the municipality. Pop. (1910) 6,960.

AUSTIN, Texas, city, the capital, and county-seat of Travis County, situated on the Colorado River. It was settled in 1836, it was first called Waterloo, but in 1837, after the Texas Revolution, incorporated and renamed after Stephen F. Austin, the Father of Texas, and the county was named after William B. Travis who was killed at the Alamo. It was made the capital of the State in 1839 and has remained such since the admission of Texas to the United States. The first free school in the State was established here in 1871. Area is 16 square miles. Altitude ranges from 650 to 850 feet. It is 81 miles north-northeast of San Antonio by the International & G. N. Railroad, 166 miles west by north of Houston, and 205 miles northwest of Galveston by the same, and the Houston & Texas Central Railroad; and on the Austin and N. W. Railroad; and on the Missouri, K. & T. Railroad. The city is beautifully located, 60 feet above the river, which here flows through very attractive scenery, is navigable for small river steamers in the winter and is spanned by two indestructible bridges. An immense dam, 1,275 feet long, 67 feet above bed rock, the twelfth longest in the world, was completed in 1916, for water supply and power. This dam creates a lake 29 miles long, known as Lake Austin, which is a favorite resort for fishing, hunting and health-seeking parties. This lake was made famous by two international regattas. Stansbury of Australia won the championship of the world on this lake. There are innumerable mountain streams flowing into the lake from the surrounding hills and mountains. The power house generates 6,000 horsepower. Much work is being done to construct beautiful drives on both sides of the lake. There is an inexhaustible supply of the best mineral water to be found, analysis is identical to the water of Carlsbad. There are 115 factories in this city, both large and small. These produce lumber, iron goods, flour and leather goods. There are oil refineries, compresses, candy factory, gins and other similar factories. There is a very large export trade in agricultural products and live stock, hides, wool, cotton and grain. Austin is also the wholesale supply centre for a great district in provisions, dry goods, drugs, agricultural implements, ranching supplies, etc. The shipment of canned goods is increasing very rapidly. One of the largest canneries in the South is located in Austin. From one to three carloads of products are shipped from this plant every day. Austin is the largest producing and shipping point for spinach in the nation. The largest silk farm in America is located here. The city is well built with wide and well-shaded streets. There are about 18 miles of paved streets. Every section of the city is supplied with artificial gas, electric lights and pure water. The sewerage system is complete in every section of the city. There are 21 miles of street railway. The most prominent building is the capitol, which is the largest State building in the United States. It is built of granite and cost $3,500,000. Austin is the educational centre of the State with the State University and its many buildings, accommodating the literary, law, educational, extension and many other departments. There is also the Blind Institute, Deaf and Dumb Institute and the Insane Asylum. There are a number of other homes and schools such as the State Confederate Home, Saint Edward's College, Tillotson College for the Colored Pupils, Saint Mary's Academy, Texas Wesleyan College, Presbyterian Theological Seminary, one business college and a number of other schools. There are two high schools and 10 ward schools. The State land office and the county courthouse are prominent buildings. The post-office receipts in 1916 were $183,054.02. There are four banks and one trust company. The bank clearings for 1916 were $134,447,420.01. There are three hospitals and eight hotels. Value of building permits in 1916 was $1,845,099. Austin is the second city in the United States to have the commission form of government. The city owns its own waterworks and electric plant. Pop. (1916) 45,763.

AUSTIN FRIARS, an old monastery, built by the Earl of Hereford and Essex in 1253 and which still stands in Broad street, London.

After the abolition of the monasteries by Henry VIII, Austin Friars became a place of worship for the Dutch residents of London, which it has remained until this day.

AUSTRALASIA, âs'trăl-ā'shĭa, a geographical term of loose application, but usually regarded by British geographers as comprehending the continental island of Australia and an unascertained number of other islands, some of them very little known, lying between long. 110° and 180° E., and stretching from Papua or New Guinea, the farthest northern island of the division, to lat. 50° S. Besides the great island of Australia, it thus includes Tasmania, New Zealand, the Loyalty Islands (New Caledonia, etc.), Norfolk Island, New Hebrides, Solomon Islands, New Ireland (Neu-Mecklenburg), New Britain (Neu-Pommern), Admiralty Islands and New Guinea, besides numerous other islands and island groups. The island of Timor and those lying west of it, though coming within the general boundary above indicated, belong to the Eastern or Indian Archipelago, called also Malaysia. Australasia is estimated to have an area of 3,740,000 English square miles, and a population of 6,400,000. It forms one of three portions into which some geographers have divided Oceania, the other two being Malaysia and Polynesia. In America the term is generally limited to Australia, Tasmania and New Zealand. Consult A. R. Wallace, 'Australasia.'

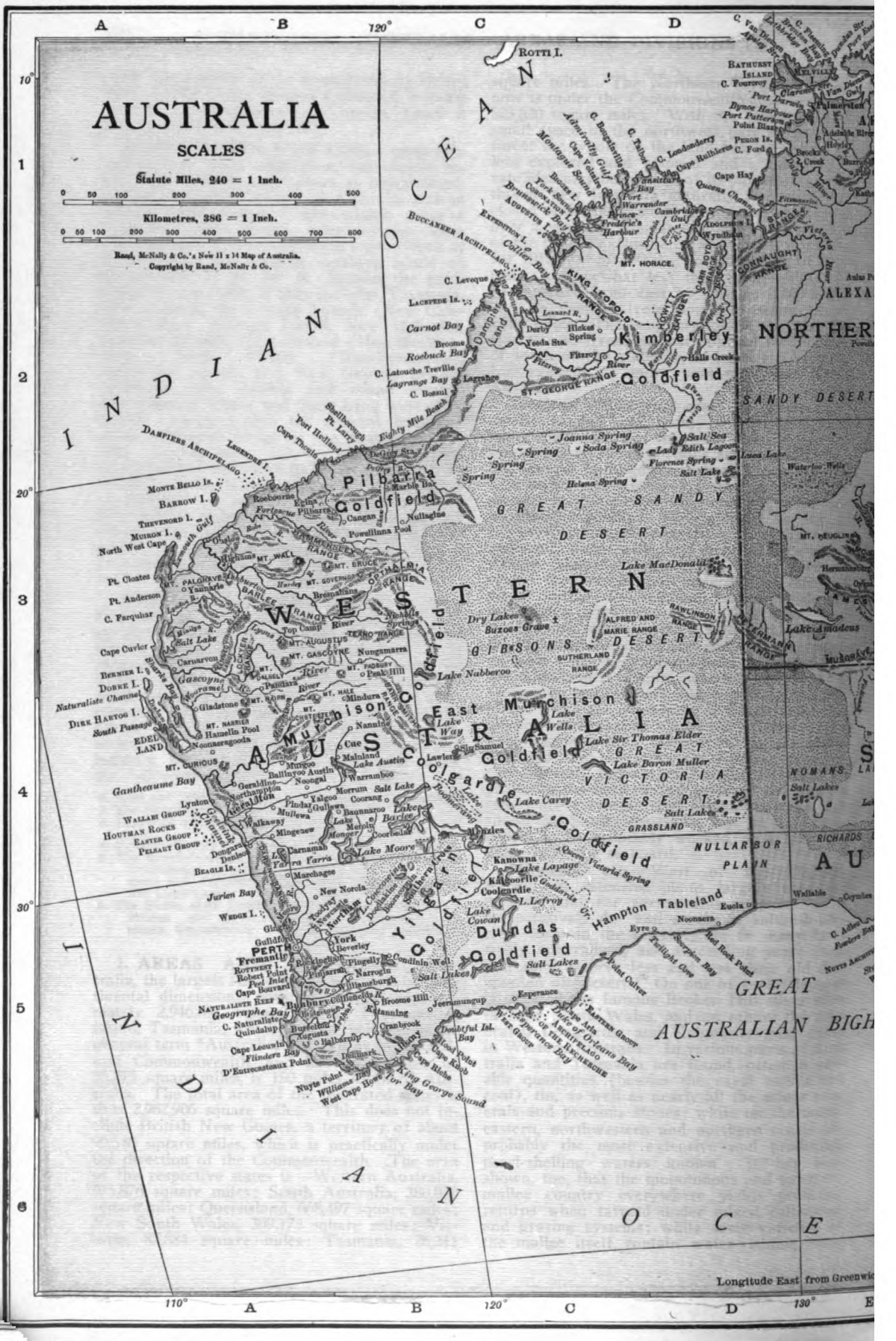
AUSTRALIA, formerly known as New Holland, the world's largest island and only sea-girt continent, lies between the Indian and Pacific oceans, to the southeast of Asia. It is separated from New Guinea on the north by Torres Strait, and from Tasmania, on the south by Bass Strait. The Tropic of Capricorn divides it into two unequal parts. In the present article Australia, its geography, historical and political development, commerce and industry, social life, etc., are dealt with under the following heads:

1. Area and Divisions
2. The Aborigines
3. Discovery and Early History
4. Political History
5. The Commonwealth, its Constitution, Government and Administrative Department
6. The States, their Constitutions and Governmental Departments
7. Municipal and Local Government
8. Education
9. Literature
10. Religion
11. Industries and Commerce
12. Finance
13. Railways and Transportation
14. The Labor Party
15. Social Conditions
16. Military and Naval Defense

1. AREAS AND DIVISIONS. Australia, the largest island in the world, is of continental dimensions, with an area of approximately 2,946,691 square miles. The smaller island, Tasmania, which is now included in the general term «Australia,» as well as in the federal Commonwealth, and has an expanse of 26,215 square miles, is 150 miles south of Australia. The total area of the federated states is thus 2,962,906 square miles. This does not include British New Guinea, a territory of about 90,540 square miles, which is practically under the direction of the Commonwealth. The area of the respective states is—Western Australia, 975,876 square miles; South Australia, 380,070 square miles; Queensland, 668,497 square miles; New South Wales, 309,175 square miles; Victoria, 87,884 square miles: Tasmania, 26,215 square miles. The Northern Territory, which now is under the Commonwealth government, is 523,620 square miles. With the exception of a small space in the northwest part of the continent the whole of the land has been more or less explored and mapped and a fairly accurate idea may be formed of its physical features, though new facts are naturally frequently disclosed with the gradual advance of settlement over a sparsely populated country. Population of the island, exclusive of aborigines, estimated for 1915 was 5,000,000. The coast-line of Australia is somewhat less than 8,000 miles. Its widest part from east to west is 2,400 miles, and its deepest from north to south nearly 2,000 miles. The configuration of the island in places is so irregular that political terminology of some of the states is misleading. Victoria, for example, is more southerly than South Australia.

Geology.—The east coast of Australia is mostly rugged and rocky, and fringed with many islets. Part of the south coast is low and sandy, but on other portions are bold cliffs rising several hundred feet sheer from the sea. The north and west coasts are generally depressed and scenically uninteresting, with monotonous sandhills. The interior, so far as explored, is largely composed of rocky tracts and sandy plains with little or no surface water, though thousands of artesian bores have revealed the presence of underground currents, which fertilize the soil, and transform deserts into highly productive areas. The whole continent is an irregular plain with high ridges in the east, and a marked depression in the centre, in some parts beneath sea-level. The base of the table-land is granite, which appears on the surface on the southern and western sides. Silurian rocks are prominent in South Australia, where unmistakable marks of glacial action have recently been discovered. In the southeast and east the rocks are volcanic, Silurian, carbonaceous and carboniferous; the coal deposits on the eastern and parts of the western coasts are extensive, and brown coal has been found in South Australia, but at too great depths to be profitably worked, at a long distance from the seaboard.

Minerals, etc.—West of the Dividing Range are extensive plains largely used for pastoral and for agricultural purposes. The comparatively dry and scrub, or saltbush-covered lands in the interior, are in many cases richly mineralized, and succeeding years show that they deserve less and less their old designation of «desert.» On one of such «deserts» is situated the famous Broken Hill silver mine in New South Wales, and on others the celebrated Coolgardie and Kalgoorlie gold mines in Western Australia. In various parts of Australia and Tasmania are found, often in payable quantities (besides the royal metals and coal), tin, as well as nearly all the minor minerals and precious stones; while on the northeastern, northwestern and northern coasts are probably the most extensive and productive pearl-shelling waters known. It has been shown, too, that the monotonous and extensive mallee country everywhere yields profitable returns when farmed under mixed cultivation and grazing systems; while some varieties of the mallee itself contain water-yielding roots


AUSTRALIA
SCALES
Statute Miles, 240 = 1 Inch.
0 50 100 200 300 400 500
Kilometres, 386 = 1 Inch.
0 50 100 200 300 400 500 600 700 800
Rand, McNally & Co.'s New 11 x 14 Map of Australia.
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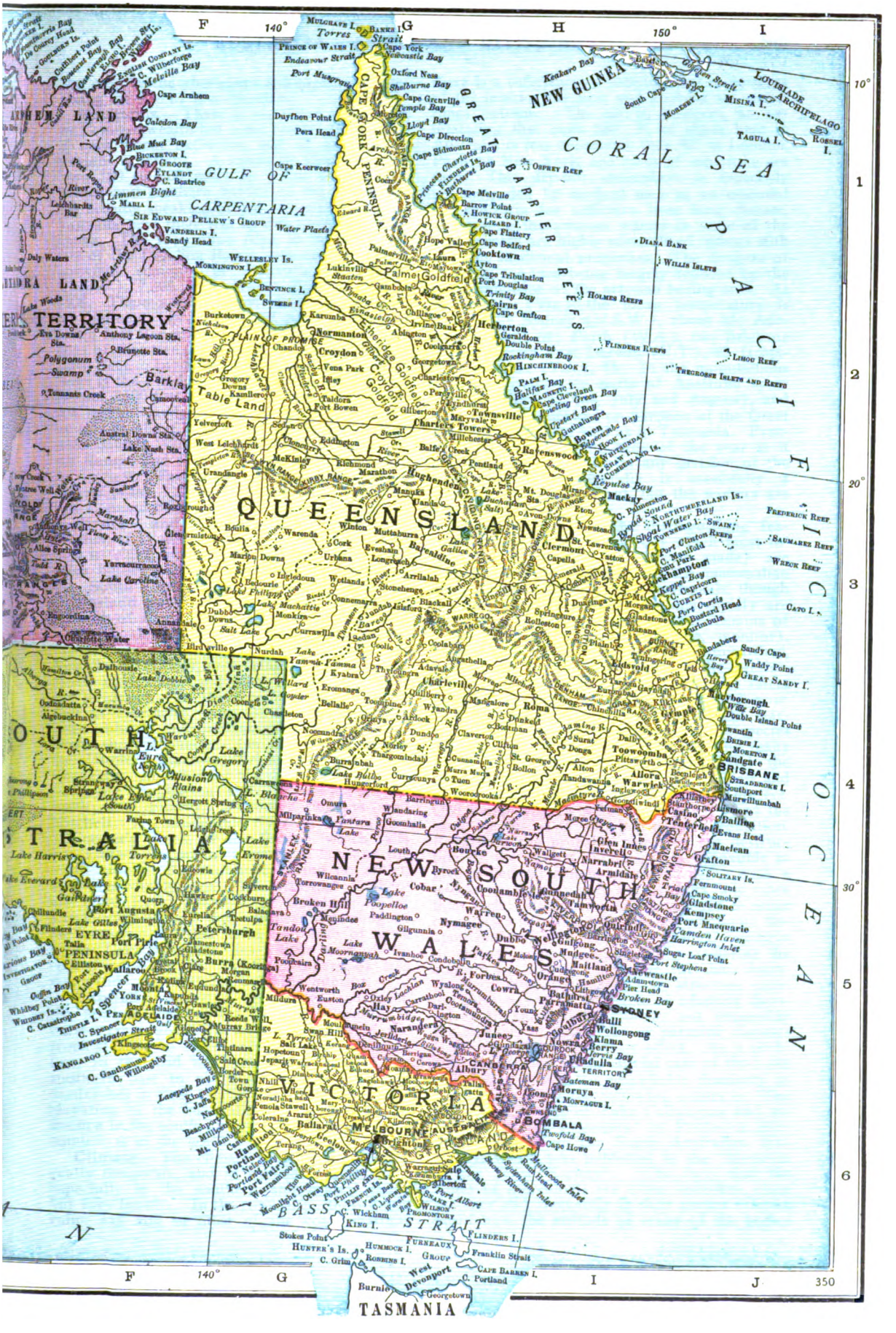
INDIAN OCEAN
AUSTRALIA
WESTERN
Kimberley
Pilbara Goldfield
Gascoyne Goldfield
Murchison Goldfield
East Murchison Goldfield
Coolgardie Goldfield
Yilgarn Goldfield
Dundas Goldfield
Hampton Tableland
NORTHERN
SANDY DESERT
GREAT SANDY DESERT
GIBSON DESERT
GREAT VICTORIA DESERT
NULLARBOR PLAIN
GREAT AUSTRALIAN BIGHT
Rotti I.
Bathurst Island
Melville I.
Van Diemen Gulf
Port Darwin
Palmerston
Cape Hay
Queens Channel
Wyndham
Cambridge Gulf
Buccaneer Archipelago
Montague Sound
Admiralty Gulf
Prince Frederick Harbour
Mt. Horace
King Leopold Range
Carnot Bay
Broome
Roebuck Bay
Lacepede Is.
C. Leveque
Lagrange Bay
C. Latouche Treville
C. Bossut
Dampiers Archipelago
Legendre I.
Monte Bello Is.
Barrow I.
Thevenard I.
Muiron I.
North West Cape
Exmouth Gulf
Shellborough
Pt. Larry
Port Hedland
Cape Thouin
Eighty Mile Beach
Roebourne
Cossack
Port Walcott
Marble Bar
Nullagine
Pilbara
Goldfield
Cangan
Fortescue River
Pilbara
Ophthalmia Range
Hamersley Range
Mt. Wall
Mt. Bruce
Mt. Sandiman
Mt. Meharry
Mt. Augustus
Mt. Gascoyne
Nungamarra
Peak Hill
Mt. Horner
Mt. Hale
Mindura
Nannine
Cue
Mt. Harris
Hamelin Pool
Noonenagoodla
Gladstone
Mt. Curious
Gantheaume Bay
Naturaliste Channel
Dirk Hartog I.
South Passage
Edel Land
Bernier I.
Dorre I.
Dorre Passage
Pt. Cloates
Pt. Anderson
C. Farquhar
Cape Cuvier
Carnarvon
Gascoyne River
Salt Lake
Top Camp
Texano Range
Barlee Range
Lake Barlee
Lake Austin
Lake Way
Lake Nabberoo
Lake Wells
Lake Sir Thomas Elder
Lake Baron Muller
Lake Carey
Lake Moore
Lake Lefroy
Lake Cowan
Lake Lefroy
Lake Lefroy
Lake Lefroy


QUEENSLAND
NEW SOUTH WALES
VICTORIA
TASMANIA
NEW GUINEA
CORAL SEA
GULF OF CARPENTARIA
GREAT BARRIER REEFS
CAPE YORK PENINSULA
LAND
TERRITORY
EYRE PENINSULA
Torres Strait
Prince of Wales I.
Cape York
Newcastle Bay
Endeavour Strait
Port Musgrave
Cape Arnhem
Caledon Bay
Blue Mud Bay
Limmen Bight
Sir Edward Pellew's Group
Vanderlin I.
Sandy Head
Wellesley Is.
Mornington I.
Duly Waters
Tennants Creek
Barkly Table Land
Austral Downs Sta.
Lake Nash Sta.
Lake Woods
Anthony Lagoon Sta.
Eva Downs Sta.
Brunette Sta.
Polygonum Swamp
Alice Springs
Yarrcurracca
Lake Caroline
Charlotte Water
Ingoordina
Annandale
Birdsville
Nurdah
Lake Yamma Yamma
Lake Eyre (South)
Lake Gregory
Strzelecki Desert
Lake Torrens
Lake Harris
Lake Everard
Lake Gairdner
Port Augusta
Port Pirie
Port Lincoln
Spencer Gulf
Gulf St. Vincent
Kangaroo I.
C. Gantheaume
C. Willoughby
Thistle I.
C. Spencer
Investigator Strait
Adelaide
Murray Bridge
Coorong
Lacepede Bay
Mt. Gambier
Portland
Port Fairy
Warrnambool
Port Phillip Bay
Melbourne
Geelong
Ballarat
Bendigo
Echuca
Swan Hill
Mildura
Wentworth
Broken Hill
Cobar
Bourke
Walgett
Moree
Narrabri
Armidale
Tamworth
Gunnedah
Dubbo
Orange
Bathurst
Parramatta
Sydney
Newcastle
Maitland
Gosford
Wollongong
Nowra
Jervis Bay
Canberra
Federal Territory
Albury
Wagga
Deniliquin
Hay
Condobolin
Forbes
Parkes
Gilgunnia
Nymagee
Cobar
Coonamble
Walgett
Inverell
Glen Innes
Tenterfield
Grafton
Maclean
Evans Head
Ballina
Lismore
Murwillumbah
Southport
Brisbane
Sandgate
Redcliffe
Caboolture
Gympie
Maryborough
Hervey Bay
Fraser I.
Sandy Cape
Waddy Point
Great Sandy I.
Double Island Point
Noosa Head
Caloundra
Moreton I.
Stradbroke I.
Toowoomba
Dalby
Roma
Charleville
Cunnamulla
St. George
Goondiwindi
Warwick
Stanthorpe
Texas
Allora
Clifton
Warrego Range
Carnarvon Range
Great Dividing Range
Darling R.
Murray R.
Murrumbidgee R.
Lachlan R.
Macquarie R.
Condamine R.
Balonne R.
Barcoo R.
Thomson R.
Flinders R.
Gilbert R.
Leichhardt R.
Gregory R.
Nicholson R.
Roper R.
Limmen Bight R.
Victoria R.
Ord R.
Fitzroy R.
Burdekin R.
Herbert R.
Johnstone R.
Mulgrave R.
Barnes I.
Cape Grenville
Temple Bay
Lloyd Bay
Cape Direction
Cape Sidmouth
Cape Melville
Howick Group
Lizard I.
Cape Flattery
Cape Bedford
Cooktown
Cape Tribulation
Port Douglas
Trinity Bay
Cairns
Cape Grafton
Herberton
Geraldton
Double Point
Rockingham Bay
Hinchinbrook I.
Palm I.
Halifax Bay
Lucinda
Cape Cleveland
Bowling Green Bay
Upstart Bay
Guthalungra
Bowen
Edgecumbe Bay
Hook I.
Whitsunday I.
Shaw I.
Cumberland Is.
Ratenswood
Repulse Bay
Mackay
Broad Sound
Northumberland Is.
Shoal Water Bay
Townshend I.
Swain
Port Clinton Reefs
C. Manifold
Port Curtis
C. Capricorn
Curtis I.
Keppel Bay
Rockhampton
Yeppoon
Gladstone
Bustard Head
Agnes Water
1770
Lady Elliot I.
Lady Musgrave I.
Bundaberg
Burnett Range
Kilkivan
Gympie
Nambour
Caloundra
Redcliffe
Caboolture
Ipswich
Esk
Boonah
Beaudesert
Logan R.
Brisbane R.
Pine R.
Stradbroke I.
Moreton I.
Southport
Murwillumbah
Tweed Heads
Byron Bay
Ballina
Lismore
Casino
Kyogle
Grafton
Maclean
Evans Head
Coffs Harbour
Nambucca Heads
Port Macquarie
Camden Haven
Barrington Inlet
Sugar Loaf Point
Port Stephens
Broken Bay
Pittwater
Manly
Botany Bay
Port Hacking
Kiama
Gerringong
Shoalhaven
Ulladulla
Batemans Bay
Moruya
Montague I.
Bombala
Twofold Bay
Cape Howe
Mallacoota Inlet
Gabo I.
Wilsons Promontory
Port Albert
Lakes Entrance
Gippsland Lakes
Snowy River
Sydenham Inlet
Rabbit Head
Western Port
Phillip I.
Port Phillip Bay
Queenscliff
Portsea
Sorrento
Frankston
Dandenong
Brighton
Geelong
Portland
Port Fairy
Warrnambool
Belfast
Port Albert
Wilsons Promontory
King I.
Bass Strait
Flinders I.
Furneaux Group
Hunter's Is.
Hummock I.
Robbins I.
C. Grim
Cape Barren I.
Franklin Strait
Stokes Point
Devonport
Burnie
Georgetown
C. Portland
C. Wickham
Osprey Reef
Diana Bank
Willis Islets
Holmes Reefs
Flinders Reefs
Frederick Reef
Saumarez Reef
Wreck Reef
Cato I.
Limoo Reef
Tregrosse Islets and Reefs
Louisiade Archipelago
Misima I.
Tagula I.
Rossel I.
Keakaro Bay
Milne Bay
Glass Strait
South Cape
Moresby I.
Solitary Is.
Fermount
Cape Smoky
Gladstone
Kempsey
Camden Haven
Barrington Inlet
Sugar Loaf Point
Port Stephens
Broken Bay
Pittwater
Manly
Botany Bay
Port Hacking
Kiama
Gerringong
Shoalhaven
Ulladulla
Batemans Bay
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Hunter's Is.
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Robbins I.
C. Grim
Cape Barren I.
Franklin Strait
Stokes Point
Devonport
Burnie
Georgetown
C. Portland
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F
G
H
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J
140°
150°
10°
20°
30°
350

long used by the aborigines and capable of sustaining the life of lost travelers.

Mountains.— There is no active volcano in the Commonwealth but some craters show signs of only recent extinction and of intermittent previous eruptions. A mountain range varying from 100 to 200 miles in width outlines the eastern and southern border of the continent; and, broadly speaking, all the rivers of Southern Australia take their rise in this Great Dividing Range. The Australian Alps, in the southeast part of the Dividing Range, contain the highest mountain summits in Australia — Kosciusko (N.S.W.), 7,308 feet; Mount Bogong (Vic.), 6,508. These are the most elevated points on the continent. In Queensland peaks in the Belenden Ker Range rise to 5,400 feet, and in other parts of the state are several eminences of about 4,000 feet. In South Australia the loftiest range is the Flinders — Mounts Remarkable and Brown, 3,100 feet each; and the principal elevation in the Gawler Range in the northwestern interior is about 2,000 feet. In Western Australia Mount William (3,000 feet) in the Darling Range, and Ellen's Peak (3,420 feet), are the loftiest. Tasmania is very mountainous — highest peaks, Cradle Mountain 5,069 feet, and Ben Lomond 5,010 feet.

Rivers and Lakes.— The Australian "Father of Waters" is the river Murray, which with its chief tributary, the Darling, flows 2,400 miles before reaching the Southern Ocean on the South Australian coast, and with its Queensland extensions has in favorable seasons a length of about 3,000 miles navigable by small steamers. It is under agreement between the riparian states (South Australia, Victoria and New South Wales), now being looked to to improve navigation, and also to provide water for irrigation. In the Northern Territory, as well as elsewhere, some of the rivers are of large volume, and are navigable for comparatively short distances. On the east coast are the Hunter, Clarence, Brisbane, Fitzroy and Burdekin; on the west the Swan, Murchison, Gascoyne, Ashburton and De Grey; on the north the Fitzroy, Victoria, Flinders and Mitchell. A considerable river on the interior is Cooper's Creek, or the Barcoo, which falls into Lake Eyre, one of a group of lakes on the south side of the continent having no outlet, and, accordingly, salt. The principal of these are lakes Eyre, Torrens and Gairdner, all of which vary in size and saltiness according to the season. Another large salt lake of little depth, Lake Amadeus, lies a little west of the centre of Australia. Various others of less magnitude are scattered over the interior.

Rainfall.— Speaking generally, wherever the land is elevated the rainfall is good. It varies from about 70 inches annually in the tropical zone to three or four inches or even less, in the arid interior regions, and in the southern part to about 40 inches. The fall diminishes in close relation to the decline in the elevation of the land, allowing for coastal influence in the south, and tropical or sub-tropical conditions in the north.

Climate.— The climate of Australia is generally temperate, and in summer hot and dry, especially in the southern and central parts, but very healthy. In the tropical portions heavy rains fall and in most of the coast districts there is a sufficiency of moisture but in portions of the interior the heat and drought are sometimes extreme. The air is, however, so exhilarating that even 120° F. of shade heat in Australia is less oppressive than 90° in London, Paris or New York, and cases of sunstroke are rare. This dry-hot atmosphere is especially recommended by medical men as an essential for sanitoria for sufferers from lung disease, and among the artesian waters in some of the arid country are highly mineralized springs with valuable medicinal properties. The dangers of drought, too, are being largely reduced by the rapid extension of the artesian boring area. At Melbourne (Vic.) the mean temperature is about 57°; Sydney (N.S.W.), about 63; Adelaide (S.A.), 61; Perth (W.A.), 64; Brisbane (Q.), 68; and Port Darwin (N.T.), 82 (tropical); Hobart (Tas.), 55. In the mountainous and more temperate parts of Australia snow falls in winter (June, July and August), and long remains unmelted on portions of the Great Dividing Range, as well as in Tasmania. Practically, however, at no time of the year is it possible to skate on ice in any division of the Commonwealth. Australia is essentially a warm country throughout, but the winters are keen and bracing.

Fauna (*extinct*).— The distinguishing features of the extinct fauna (of which most interesting discoveries have been made) are specially worthy of note. In the mammalian class the great majority are marsupials, though the dingo and the whale (non-marsupial) are also found in a fossil state. Fossil remains of birds, reptiles (such as crocodile, monitor), turtles and fishes, have also been unearthed, some in the banks of the rivers in the interior. This indicates that the ancient vertebrate fauna of Australia was very similar to what it is now. The preponderant type of mammal was marsupial. In most respects, however, the species and even the genera were different, and many (such as *diprotodon, nototherium,* and the giant kangaroo) were much larger animals and of a more generalized type than exist at present. One living type (a wombat) is precisely of the same species as is found in a fossil condition. Regarding the probable cause of the destruction of the extinct animals, it is impossible to give a general statement applicable to such a wide-stretching country as Australia, any more than such a statement could be applied to other countries where there has been a wholesale disappearance of once numerous groups. Changes of climate or physical conditions rendering the country or district unsuitable for their maintenance; over-specialization in structure causing the types to be incapable of adapting themselves to changed conditions; not impossibly the ravages of infectious or parasitic diseases — all these have had their effect. As a probable explanation in the special case of the Lake Callabonna fossils (a remarkable discovery in South Australia) the following occurs in 'The Physical Features of Lake Callabonna and the Account of the Discovery' by Professor Stirling (director of the South Australian Museum), which was published in the 'Memoirs of the Royal Society': "The facts that the bones of individuals are often unbroken, close together and frequently in their proper relative positions — the attitude of many of the bodies

and the character of the matrix in which they are imbedded — negative any theory that they have been carried thither by floods. The likelihood, rather, is that they met their death by being entombed in the effort to reach food and water. . . . The accumulation of so many bodies in one locality points to the fact of their assemblage around one of the last remaining oases in the region of desiccation which succeeded an antecedent condition of plenteous rains and abundant waters.» An identical explanation has been suggested by Daintree in his 'Notes on the Geology of the Colony of Queensland.' Among the extinct fauna the most remarkable of the mammals is the *Diprotodon australis;* size 10 to 11 feet in length, five and one-half to six feet in height. Of the birds, the most noteworthy is *Genyornis newtoni,* a large bird with bones as big and massive as the elephant-footed moa of New Zealand, and the *Aepyornis* of Madagascar. It stood about six and one-half feet high, but is remarkable mostly for its massiveness. The deposit of this treasure trove of natural history at Callabonna is large and valuable, but (so far as the ground has been explored) it does not equal the immense deposits in certain places of fossil mammals and reptiles in the United States of America. Still, only one area of limited extent in Lake Callabonna has been exploited. Owing to the superior resources of the United States, and the greater generosity displayed there in this direction, much more systematic search has been undertaken both in that country and in South America than in Australia; but the possibilities are cherished of further revelations of the highest importance in this branch of research in the Commonwealth.

Fauna (*existing*).— To the northwest of Australia between the Dutch-Javanese islands of Lombok and Bali runs the Lombok Strait, which curiously marks a dividing line between the fauna and the flora of Asia and those of Australia. The channel is narrow, if very deep, and the Asiastic birds might easily fly across it in one direction and the Australian in another. So might a natural growth of plants be encouraged by the agency of wind and feathered carriers of seed; but none of these things has happened to any extent; the individuality of the relative fauna and flora has been strongly preserved. A number of the birds in Australia, however, migrate from one part of the Commonwealth to others with the changes of the seasons, and some pass to and from the continent of Asia — e.g., the sandpiper or sharp-tailed stint, that each season comes from Siberia, a distance of 10,000 miles. As already indicated, the existing fauna does not differ widely (except in proportions) from the extinct; and the forms observed in some instances are exceedingly interesting, if not bizarre. The «Bunyip» of the aborigines' legends (a monster that lurked in certain rivers and creeks and swamps) has never yet been proved to be other than fabulous. Much speculation and some mystery, however, surround the occasionally recurring visitations of plagues of rats in the far-northerly country, and of mice in the more southerly or agricultural areas. At periods of several years the rodents suddenly appear in vast numbers, and as suddenly disappear after doing, in some cases, much damage. The locust or grasshopper plague, which at one time was much feared, is now almost unknown. In a generalization, Australia may claim to be free from all animals that attack man, except in exceedingly rare instances when a large kangaroo may be brought to bay, and in frenzy of fear strive to defend itself almost invariably vainly. Introduced animals, such as the rabbit and the fox, the sparrow, the starling and other old-world birds, as well as the snail, multiply literally by millions, and become a scourge to sheep raisers, farmers and gardeners. The imported dog running wild has sometimes been confused with the aboriginal dingo (*canis dingo*) (q.v.) or «warrigal» (native name), a predatory animal, the wolf of Australia, that has caused heavy losses among sheep and lambs, which he destroys in mere wantoness. The dingo never barks, but howls dismally in the bush at night. Kangaroos once abounded virtually all over Australia, and varied in size from the «old man» of six feet to the most minute specimens, including the wallabies and kangaroo rats. The most interesting example is the tree kangaroo, discovered in Queensland about 100 years after and not far from the spot (Endeavour River), where the first kangaroo (*Macropus major*) was found by Captain Cook, the great navigator, in 1770. In particularly the southern and western parts of Australia is seen a small «native bear,» that inhabits trees, and, in Tasmania, the «Tasmanian devil» (*sarcophilus ursinus*), fierce and (like the dingo) untamable, and the «Tasmanian tiger» (*Thylacinus cynocephalus*) are the principal examples of fauna. The numbers of these latter, like those of the kangaroos and the opossum, have been largely reduced through indiscriminate slaughter with the advance of settlement; but recent legislation for the protection of the kangaroo (the skin of which is valuable for export) has stayed the race toward destruction. The wombat (*Phascolomys*) is a curious, burrowing, land animal, resembling in some respects the platypus and kindred creatures; but the most extraordinary is the platypus itself (*ornithorhynchus anatinus*), an amphibious animal that forms a connecting link between the mammals, birds and reptiles. Of the birds the emu (*Dromaius novæ hollandiæ*) is from five to six feet high, and ranks next to the African ostrich, which it resembles in its habits; its numbers, as with the kangaroo, have been greatly reduced as settlement has progressed. The cassowary (*Casuarius australis*) is small, and not nearly so widely diffused as the emu; and the native companion or Australian crane (*Grus australasianus*) is still slightly smaller than the cassowary, and an exceedingly graceful bird of somewhat eccentric habit. The black swan (*Cygnus atratus*) is scarcely so large as the white swan of the northern hemisphere, but is a beautiful bird. Strange in its habits is the satin bower-bird (*Ptilonorhynchus holosericeus*) that forms for itself a playground or bower in which it sports with a miscellaneous collection of bright objects. Altogether about 750 species of birds have been found, mostly in northeast Australia (which has been chiefly explored), but some of them are gradually becoming extinct. The old idea that Australian birds are songless is only relatively true. The flute-like note of the magpie or shrike is one of the most mellifluously melodious sounds in nature, and

has been declared to surpass that of the nightingale. The reptiles are numerous. The largest of the snakes is the carpet snake (*Morelia variegata*), non-venomous, with an average length of about seven or eight feet, but with authenticated specimens up to 15 feet and even more; its habits are generally similar to the python's. Of the five principal poisonous reptiles the most deadly is the death adder (about three feet). Not more than 12 or 15 fatal cases of snakebite occur annually throughout Australia, but this comparative immunity is due partly to the prompt application of effective remedies. The white ant is common in the northern part of the Commonwealth, and is very destructive to wooden buildings in the early stages of settlement; its nests of mud and clay, generally with angles pointing north and south, range from 20 feet in height downward. The seas abound in numerous varieties of fish. In the period of pioneer settlement the Australian whaling grounds were very productive, and still are occasionally exploited with profit. Sharks are exceedingly numerous. The largest, the white pointer or white shark (*Carcharodon rondeletii*), to the length of 16 feet and over has been caught, and attended by the pilot-fish (*Naucrates ductor*) it preys upon man as well as upon denizens of the deep. Deaths through sharks are rarer even than those from snakebite, but this is to a large extent due to the precautions taken in bathing in the seas. The crocodiles or alligators, as they are popularly called (*Crocodilus Porcatus and Phyllas johnsonii* — a small variety), are plentiful in the tropical and sub-tropical zone on the northeast, northwest and north coasts; they vary from about 20 feet (an unusual length) to five or six feet. In common with the shark the larger alligator sometimes attacks human beings, but the aborigines evidently stand in little fear of it. In the warmer waters is found the dugong (*Halicora australis*), from whose habits and structure doubtless originated the fables concerning the mermaid. Seals are still seen on the remote parts of the coast and the southern islands. The most noteworthy is the sea bear (*Otaria cinerea*) of about seven feet in length, that is more prized for its oil than for its skin. In the northern waters turtles, the edible green (*Chelone Mydas*), and the shell-yielding hawkbill (*Chelone imbricata*) varieties are very numerous, and attain to a large size. The trepang or bêche-de-mer is found, with the mother-of-pearl oyster — large (*Meleagrina margaritfera*) and small (*Meleagrina radiata*). The former frequently yield fine pearls, some single specimens of which have been sold for thousands, and many for hundreds, of pounds. The edible rock oyster is widely represented, and the mangrove tree-climbing fish (*periophthalmus*) abounds particularly in the northern waters.

Flora.— In a concise description the Australian flora may be said to possess peculiarities which distinguish it unmistakably. Many of its most striking features bear a natural relation to the general dryness and greatly differing conditions of the climate, owing to the vast area of the Commonwealth. The trees and bushes have mostly a scanty foliage, with little surface for evaporation, or thick leathery leaves well fitted to retain moisture. Nearly all are evergreen, but the effect upon the landscape is rather monotonous. The most extensively spread types of vegetation are the various kinds of gumtree (*Eucalyptus*), the shea-oak (*Casuarina*), the acacia or wattle, the grass tree (*Xanthorrhœa*), many varieties of the *Proteaceæ*, a few baobab trees, and very many ferns and tree-ferns. Of the gumtree there are more than 150 species, nearly all valuable for timber, and for their essential oils, which possess important medicinal properties. The wattle or acacia includes about 300 species, some of which also yield good timber or bark for tanning. The most beautiful, the most fragrant and the most useful in these latter respects is the golden wattle (*Acacia dealbata*). Palms (of which there are at least 24 species, all, except the cocoa-palm, peculiar to Australia) are mostly confined to the northern and eastern coasts. The mallee scrub is formed by a dwarf eucalyptus, and the mulga scrub by a thorny acacia. A plant which covers large areas in the arid regions is the spinifex or porcupine grass (coarse and spiny), which renders traveling difficult, and is uneatable by any animal. Other expansive tracts are occupied by useful herbs and fodder bushes. Foremost among those stands the salt-bush (*Atriplex mummularia*, order *Chenopodiaceæ*), an exceedingly hardy plant, upon which the sheep and other animals thrive, and which has strong drought-resisting powers. Beautiful flowering plants, especially in Western Australia, are almost innumerable. Australia also possesses many turf-forming grasses, particularly the kangaroo grass (*Anthistiria australis*), which survives in even a protracted rainless period. The native fruits, including the native cherry (*Exocarpus cupressiformis*), the nut of which grows partially outside of the fruit proper, are few and of little practical worth, and the plants yielding roots used as food are not of much economic value; but exotic fruits and vegetables grow everywhere in unstinted abundance, and some of the cherished garden blooms of the older countries flourish so riotously as to become a pest in Australia. The vine and the olive thrive better than in the country of their origin, and enormous quantities of wine and oil are produced and exported. The cereals of Europe and maize are extensively cultivated, and large tracts of country, particularly in Queensland, are under the sugar cane, the pineapple, the cocoanut and other tropical exotics.

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2. THE ABORIGINES.— The aborigines of Australia are fast dying out — slain by civilization through interference with the game that they formerly hunted and lived on, added to the influence of the white man's diseases and vices. It has always been impossible to number the aborigines with any certainty on account of the immense territory over which they were scattered, and of the nomadic habits of the people — habits which quite unfitted them for any sustained industrial work; but, according to the most trustworthy estimates which can be obtained, only about 80,000 of the blacks (including half-castes) now remain upon a territory of nearly 3,000,000 square miles. Certainly this is nearly four times the number of Maories who are left in New Zealand, but the territorial and other conditions are so essentially different in the two countries that comparisons are practically valueless. It is assumed that the representatives of the Australian aborigines are distributed in these proportions in the respective states: Western Australia, 26,000; South Australia and the Northern Territory, 29,896; Queensland, 20,000; New South Wales, 4,716; and Victoria, 269. In Tasmania the last pure-bred aborigine died in 1877; but a few half-castes remain. Even on the Australian continent the sight of a full-blooded black near to a centre of settlement is very rare; and probably during the next 20 years the few survivors of the original owners of the soil will be found in only the remote districts.

Treatment of the Aborigines.— Although the racial antipathies and collisions due to the seizure by superior races of the lands of inferior peoples have been at least as marked in Australia as elsewhere, and although the treatment of the aborigines by many of the pioneer settlers did not err on the side of scrupulous humaneness, the governments, as such, have done a good deal to mitigate the sufferings of the unfortunate people, the dealing with whom was more difficult than it would have been if the vast majority of them had not in hopeless indolence always manifested an unconquerable repugnance to systematic labor or anything like sustained industry. The policy shown toward them might well have reflected — and in some cases it has done so — the fact that the conquest of the natives in Australia has been exceedingly easy owing to their utterly disorganized condition and their almost complete helplessness. These defects were in contrast to the valor, the country-love and the mental alertness of the colored inhabitants whom the early white settlers found in New Zealand. As a rule the Australian aborigine — while in good districts physically stalwart and strong — was not of a ferocious or blood-thirstily aggressive nature; and in most cases when numbers of them have attacked a few isolated European settlers or travelers, the cause has been either a lack of firmness or judicious care on the part of the persons molested, or else revenge for wrongs inflicted upon the natives by other white men, mostly in the shape of interference with the black women, or by way of reprisals for the killing of cattle, the intrusion of which upon their former hunting grounds the blacks naturally connected with the gradual disappearance of the indigenous game.

All the state governments have enacted, and so far as possible enforced, laws for the protection of the blacks — laws in some instances providing for them special reserves within which the Europeans must not kill game or depasture stock; prohibiting the supply of intoxicating liquor or opium to the aborigines, and defending them against anything like enslavement or other ill-usage. During many years past at least a yearly — and in bad seasons a more frequent — distribution of flour, tobacco, blankets and other useful articles has been made by the governments among the natives; and the state-aided efforts have been liberally supplemented by the benefactions of private persons and philanthropic institutions, especially in relation to education, spiritual and otherwise, by missionaries who have established aboriginal stations. In the latest year for which statistics are available the purely governmental expenditure amounted annually (with allowances for endowed lands) to £20,000 in New South Wales, £16,000 in Queensland, including the Northern

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Territory £14,000 in South Australia, £4,000 in Victoria and £24,000 in Western Australia.

Origin and Characteristics.— The origin of the aboriginal tribes of Australia has been a theme of much controversy; and the space available here is not adequate for even an enumeration of the many theories — including one comprehending an invasion by representatives of the Lost Tribes of Israel — advanced by various differing authorities. This seems to be a problem insoluble. In such circumstances sufficient must be the statement that there is a fair consensus of opinion to the effect that the native black races, as they were found by the European pioneers, had apparently been substantially affected (especially in the northern areas, which were for many centuries visited periodically by Malay proas in search of pearl shell, trepang and other products) by strains of blood introduced from beyond the island continent. A judicious balance of the evidence adduced by the most trustworthy ethnographers tends to the conclusion that the two points whence Australia benefited or otherwise by migration of fauna and flora, as well as ethnologically, were the group culminating in New Guinea on the one hand, and on the other in the chain of islands and peninsulas touching Australia on the northwest. Certain plants and animals came from Asia to Australia, and it is held to be extremely probable that the ancestors of the Australian native tribes (who differ somewhat from those of Tasmania) crossed over to Australia from those two points. The native population is declared to be an admixture of at least two distinct elements. The skin of the one was a true yellow, and that of the other was a velvety black. The hair varies from straight to woolly, and the face and skull also have material dissimilarities. The nose assumes various grades, from the flat negro to the arched Jewish, and these contrasted types are believed to be due to the immigration of Malays and Papuans as indicated.

One reason why the black had no means of sea navigation was that "the negroid blood in his veins fetters the Australian so firmly to the soil"; and another was that unkindly nature made the pressure of food requirements so heavy that the black was forced to be a wanderer, and had little time for anything else than the sustaining of bare life. As, however, this judgment reflects disparagingly upon the natural resources of the land, it is important to add that on their advent Australia's "Pilgrim Fathers" surprised the black inhabitants in a state of the most primitive savagery. There was not anywhere the remotest sign of any cultivation of the soil, or of the slightest attempt at tillage, or the thrift or providence which stores food for emergencies. Neither had the natives made — though they possessed roughly hewn bark or log canoes — any effort to clothe themselves, or — apart from miserable hovels constructed of rank grass or reeds, or boughs or bark of trees — to provide shelter from the cold of winter or the heat of summer. They had no written language, unless one may include in that characterization such crudely artistic representations as were inscribed on rocks or in caverns. Some of these, like the message sticks sent from one part of the country to another, are ideagraphic — or picture-writing — but none was at any rate unmistakably idealistic. Though most of the tribes paid deference to their "medicine men" or sages — mostly the older members of the tribal camps, who were always well treated by the younger blacks — they possessed practically no conception of abstractions. In this respect they were, while less provident than the ants, essentially untutored children of nature — almost as much so as the dogs and the lower animals. They were endowed with instinct rather than with intuition. No bloodhound ever displayed keener sight or scent than the Australian black trackers, whose power in following a trail seems almost miraculous.

On the other hand, a close study of the aborigines reveals curious anomalies. Speaking generally the natives rise and fall in mental and physical superiority in exact harmony with the fertility or otherwise of the territory over which they roamed. Some of them had scarcely reached the low stage of intelligence associated with the Stone Age, others rapidly acquired education under European teachers, and in the wilds had constructed the boomerang which, with its marvelous power of returning to the thrower, has long puzzled even the most profound scientific experimenters. Among the highest-class natives, too, the character of their spears and other weapons indicated the possession of no little constructive skill, as well as undoubted patience and perseverance on the part of the makers. Where an aboriginal population is divided into hundreds, and probably thousands, of tribes, all mutually independent and mutually hostile, and distinguished usually by arbitrarily marked rings of exclusiveness, and each tribe speaking a dialect of its own, it is impossible to write with exactitude concerning their customs. One must not, therefore, attempt to explain why the tribal boundaries should in some cases be defined by geometrical devices; why in tribal territories here and there circumcision should be practised, and on adjoining areas not observed; why some natives should exchange salutes similar to Masonic signs, and others be unaware of the meaning of this interchange, but be familiar with a somewhat intricate code of smoke signals; why some should be cannibals and others should not be; why the superstitious ceremonies should vary so widely; and yet why the main idea of the native "corroboree" or dance should be apparently almost everywhere the same or closely similar.

What seems to be certain is that the wild aborigines have no religion properly so called — no impelling attraction toward or trust in a God of Love, but a wholesome fear of "Mooldarbie" or the devil, whom all tribes sedulously seek to propitiate — some even by periodical human sacrifices, and the dread of whom as a spirit walking in the darkness keeps them shrinking in their camps until the break of day. Very extensively diffused also is the belief that nobody can die a natural death, but must be the victim of a maleficent influence or the evil eye. Equally widespread is the aspiration among the aborigines that after death they may "jump up a white fellow" — a notion said, perhaps fancifully, to have originated in the general custom of smoking the corpses of the dead, with the result that the peeling outer cuticle revealed the white dermis or true skin. Some tribes are prudishly modest in their rela-

tions with their women, others are as flagrantly immoral. The language of some seems to be little better than mere gibberish, while concerning that of others one of the Jesuit missionaries has written that in its construction it is most ingenious, and curious in its form, indicating high intelligence and suggestive of the Hebrew. Many of the natives are musical, but their musical instruments are of the crudest character, made chiefly of hollowed wood or grasses, or bamboos. At the age of puberty youths of both sexes are formally initiated by peculiar, jealously preserved, and often indescribable ceremonies, into the respective secrets of manhood and womanhood, but even the old men and women of the tribes who perform these rites — which include the knocking out of some of the young men's teeth and certain genital mutilations — seem to have no clear and coherent idea of their import.

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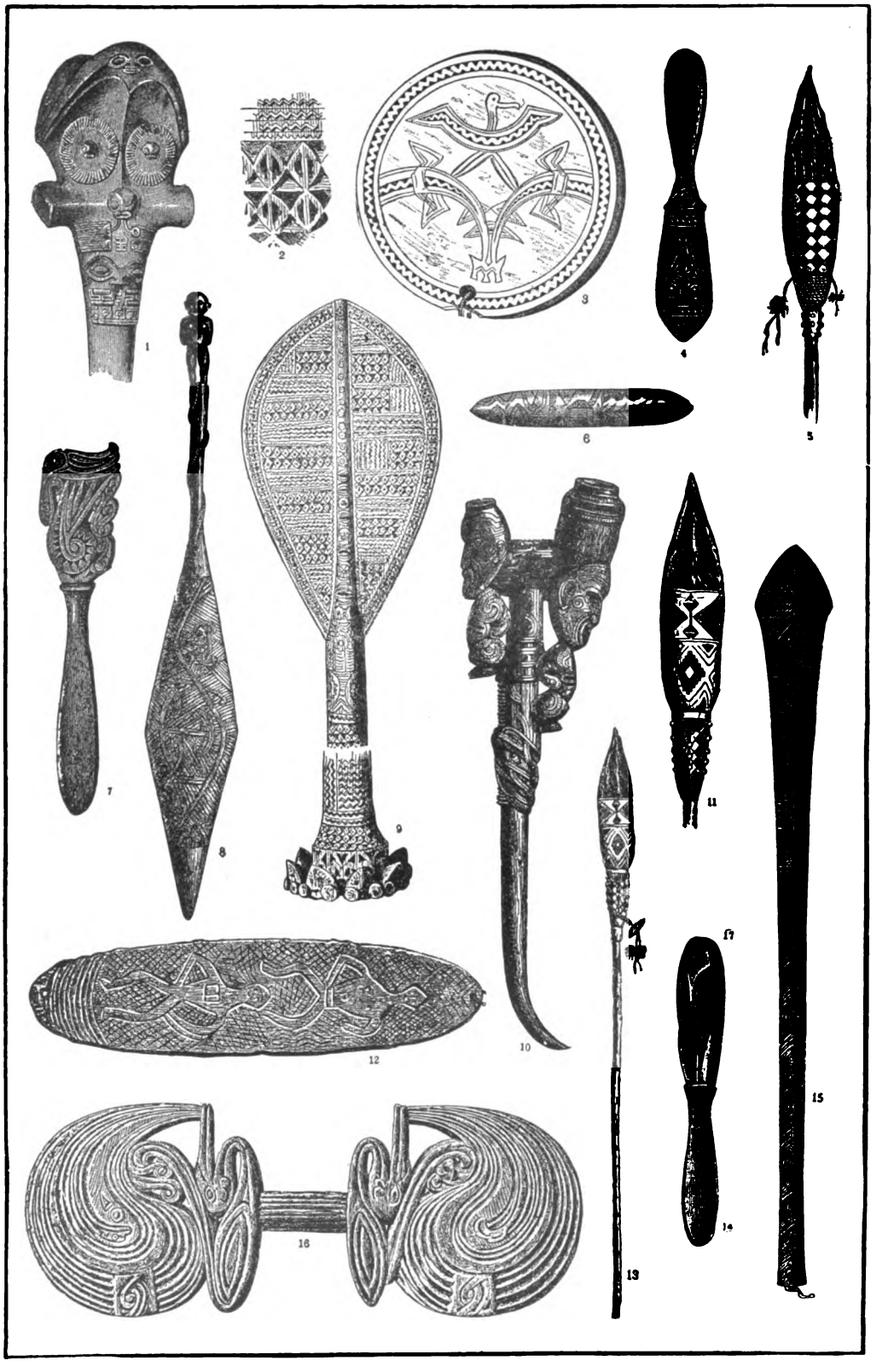
3. DISCOVERY AND EARLY HISTORY. The discovery and the early history of Australia have been the themes of much discussion, but one conclusion admitted by all disputants is that the really pioneer navigation which resulted in the finding of the great island continent of the Southern Seas was not conducted by the British who now occupy the territory that was originally called Terra Incognita, and then New Holland. British enterprise, however, built a structure of colonization upon the site disclosed by the investigations of the people of other nations; and nearly all the definite surveying of the Australasian seas has been done by the sailors of Britain.

The later days of the time in which Australia was still unknown were the days when the Portuguese, the Spaniards and the Dutch roamed the oceans as intrepid searchers for new sensations rather than in the hope of territorial aggrandisement. Though anything like the exact year in which Australia was first sighted is doubtful, records show that between 1531 and 1542 the Portuguese declared the existence of a land which they styled "Great Java," and which corresponded with the northern parts of what is now the Australian Commonwealth. The most authentic available data indicate that the first European who saw the land was a Portuguese named Manoel Godhino de Eredia, who sighted it in 1601. By common consent, however, it has been conceded, as a starting point for Australian history, that Luis Vaez de Torres, who had been second in command of the De Quiros (Spanish) expedition, saw and sailed close to the Australian coastline in 1606; and that he was navigating in the neighborhood of New Guinea to the east of Cape York Peninsula at about the same time when a Dutch mariner was similarly engaged to the west of the peninsula. Yet centuries elapsed before any attempt was made to settle the newly-found continent, though meanwhile it was more than once passed and even circumnavigated. After 1619, when the Dutch expedition under de Houtmann anchored off the Abrolhos Reef on northwest Australia, that part of the continent was repeatedly visited during the earlier half of the 17th century, and well-verified history shows that in 1656 a Dutch ship was wrecked in the vicinity of the Abrolhos Group — fragments of the cargo are even now washed up occasionally by the sea or found in the guano deposits. Toward the end of 1642 Abel Jansen Tasman, a Dutch navigator, discovered and landed on Tasmania, and named it Van Diemen's Land (a title which it continued to bear until 1854). In 1688 William Dampier, a freebooter, was the first English man to set foot on Australia — at King Sound on the northwest coast. This same Dampier on a subsequent voyage took Alexander Selkirk (Defoe's "Robinson Crusoe") off the island of Juan Fernandez, on which the man had disembarked some time before. Still, curiously enough, Australia was not annexed on behalf of any nation until the last third of the 18th century. In 1768 Lieut. James Cook set out from England in a crazy ship, the *Endeavour,* in charge of an expedition appointed to observe at Tahiti the transit of Venus. Steering thence westward, he made an examination of New Zealand, came on 19 April 1770, upon the east coast of Australia and anchored in Botany Bay. Later he proceeded northerly along the coast; and, after the *Endeavour* had in June struck upon a coral reef and well-nigh foundered near to the present Queensland port of Cairns, he continued his journey until on 21 Aug. 1770, he hoisted the colors of England on the north Australian peninsula of Cape York, and thus formally took possession of the whole eastern part of Australia.

But settlers did not follow closely upon the heels of the navigators, and 18 years had passed before, on 18 Jan. 1788, a British convict expedition with 1,030 persons, of whom 750 were under penal servitude and banishment, reached Botany Bay. On 26 January (now celebrated as Australian Foundation Day) the expedition landed, displayed its national colors with due pomp and circumstances, and so inaugurated European settlement in the "Great Land of the Southern Cross," which was, however, even thus late imperfectly known even in outline, and was comprehended under the general title of New South Wales, now applied to one of the territorially smallest states of Australia. With the occupation of the country further exploration by land and by sea proceeded apace. In 1798 Dr. Bass and Captain Flinders (who afterward achieved immortal renown as a great navigator in association with Sir John



1–5 Clubs from the Marquesas Islands
2, 9 Carving from Hervey Islands
3 Shell Ornament from the Solomon Islands
4, 7, 14 Carved work from New Guinea
5, 11, 13 Obsidian Lances
6 Australian Carving
8 Steering Oar, from New Zealand
10 New Zealand Pipe
12 Australian Carved Ornament
16 Carved Shield from New Guinea

Franklin, the Arctic hero) demonstrated by sailing around Tasmania that that country was veritably an island, and not a portion of the Australian continent, as had been supposed. In 1802, having been provided by the British Admiralty with a scarcely seaworthy vessel, the *Investigator,* Captain Flinders surveyed the larger part of the southern coast of Australia, from west to east, and forestalled a French expedition which had been sent out under Captain Baudin in the ship *Le Geographe,* for purposes similar to those Flinders had in view.

The course of further marine exploration need not be further pursued; for the initial work had been accomplished. In 1803 the first colonization settlement was begun in Van Diemen's Land (Tasmania). In 1804 an unsuccessful attempt was made by Col. David Collins, first governor of Tasmania, to found another convict colony in the now prosperous state of Victoria, which, however, from that time remained for 30 years with only one white man in it — a deserted convict named William Buckley, who dwelt among the aborigines until the year 1834, when real occupation was started, 10 years subsequent to the founding of Queensland, five years after that of Western Australia, and two years before that of South Australia.

During all the intervening time the exploration of the interior of the continent, mainly from Sydney, had been steadily progressing. First the disclosing of a means of passing beyond the Blue Mountains in 1813 showed (by Blaxland) a way out of what had been regarded as an impasse preventing access from the coastal fringe to the expansive interior territories which represented the Mystery Land of the early colonists. In 1824 Hume discovered the upper Murray, the head of the great Australian Mississippi. Following the course of that river in 1828, Capt. Charles Sturt added to the geographics of the period the name of its tributary, the Darling; and in 1830 he made, with almost sensational intrepidity, a journey down the Murray to its junction with the sea not far from Adelaide (the present capital of South Australia). In many directions other explorers were contemporaneously (and subsequently) causing the wilderness of the Terra Incognita of the Portuguese to yield up its secrets, but only two of the dauntless explorers who have laid mankind under obligation to them for all generations need be particularly mentioned here. One of these was Ludwig Leichhardt, who started out from the east in 1848, and (with all the members of his party) apparently disappeared mysteriously and absolutely from the face of the earth; for no sign or trace of the expedition has ever since been seen or heard of. The other was John McDouall Stuart, who, after having been repeatedly baffled, succeeded at last in crossing the continent from south to north, and on 24 July 1862, laved his hands in the waters of the Indian Ocean, and hoisted the British flag on the northern shores of Australia. And now in this year of 1918 practically all the blank spaces in the Commonwealth may have been filled in by the cartographer, and Australia has no further laurels of fame to offer as worthy guerdons to brave and daring explorers by land or by sea.

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4. POLITICAL HISTORY. Beginnings of Colonial Self-Government.— It was a maxim of the common law that, if an uninhabited country were discovered and peopled by British subjects, they were supposed to possess themselves of it for the benefit of their sovereign, and that such of the laws of England as were applicable and necessary to their situation and the conditions of an infant colony were immediately in force; that wherever an Englishman went he carried with him as much of English law and liberty as the nature of his circumstances required. It was recognized that Englishmen carried their political birthright with them over the broad surface of the earth; that the charters of freedom for which their ancestors fought were not left behind, but accompanied them to their new homes beyond the seas.

The colonial legislatures of Newfoundland and Jamaica were established not by British statutes, but by royal commissions under the great seal accompanied by royal instructions. Local self-government in Australia did not, however, originate in the exercise of the prerogatives of the Crown, as it did in the case of some of the early North American and West Indian colonies. From the very first it was founded upon, as it was subsequently developed and built up by, statutory authority.

NEW SOUTH WALES THE FIRST ORIGINAL COLONY.

Foundation.— In 1784 the British Parliament passed the statute of 24 Geo. III, c, 56, entitled «An Act for the effectual transportation of felons and other offenders, and to authorize the removal of prisoners in certain cases, and for other purposes therein mentioned.» This law empowered the King, with the advice of the Privy Council, to appoint places to which felons might be transferred. By an order in council bearing date 6 Dec. 1786, His Majesty's «territory of New South Wales, situated on the east part of New Holland,» was appointed a place for the reception of persons within the meaning of the act.

By letters patent and commission dated 2 April 1787, Capt. Arthur Philip was appointed governor of the territory. The limits of his authority extended from Cape York on the north to the southern extremity of the coast of the continent and inland and westward as

far as the 135th meridian, which was afterward extended to the 129th meridian east longitude. The governor was empowered to make orders for the good government of the settlement.

By the Act of 27 Geo. III, c. 2, the King was authorized to establish a Court of Criminal Jurisdiction on the eastern coast of New South Wales. Such was the legal authority under which, on 26 Jan. 1788, a penal settlement was established at Sydney Cove. In was not at first intended to be a colony, or plantation, for the purposes of trade and cultivation, within the ordinary meaning of those terms.

The First Constitutional Charter.— The temporary Act 4 Geo. IV, c. 96 (1823), which became law during the governorship of Sir Thomas Brisbane, was the first legislation passed by the Imperial Parliament conferring anything like the rudiments of local self-government on the New South Wales community. A council of five persons was appointed having limited legislative powers. On 17 May 1824, a Charter of Justice, creating a Supreme Court, was promulgated.

The Second Constitutional Charter.— The Act of 9 Geo. IV, c. 83 (25 July 1828), passed during the governorship of Lieutenant-General Sir Ralph Darling, was the second Constitutional Charter of Australia. Courts of Criminal and Civil Jurisdiction, coupled with trial by jury, were organized. The laws and statutes in force within the realm of England, so far as applicable, were applied to the administration of justice in New South Wales and Van Diemen's Land. The Crown was authorized to constitute in New South Wales and Van Diemen's Land, respectively, an Advisory Council to consist of such persons residing in the said colonies respectively, not exceeding 15, and not less than 10, as the King might be pleased to nominate.

The Third Constitutional Charter.— The third charter regulating the government of New South Wales was the Act 5 and 6 Vic., c. 76 (30 July 1842), passed during the governorship of Sir George Gipps. This act established for the first time in Australia a legislature, partly, but not wholly, representative in its character. It enacted that there should be within the colony of New South Wales a Legislative Council consisting of 36 members, 12 of whom were to be appointed by the Crown, and 24 were to be elected by the inhabitants of the colony having certain property qualifications. The governor, with the advice of the Council, was authorized to make laws for the peace, welfare and good government of the colony, provided that such laws were not repugnant to the laws of England; nor were they to interfere with the sale or occupation of the waste lands of the Crown. Bills imposing duties of customs had to be reserved fo the Queen's assent. This act did not grant to New South Wales the system known as "Responsible Government." The governor presided over and managed all the public departments. It contained, however, the feeble germs whence has since sprung the splendid fabric of parliamentary institutions in Australia. It was the first concession made by enlightened British statesmen to the growing wealth and importance of the Australian colonies.

The new Council was opened by Sir George Gipps on 1 Aug. 1843.

The Fourth Constitutional Charter.— The next important charter granted to Australia was 13 and 14 Vic., c. 59 (5 Aug. 1850, entitled "An Act for the better government of Her Majesty's Australian Colonies," and commonly known as the Australian Colonies Government Act. The bill, of which this act was the outcome, was first introduced into the House of Commons in June 1849. The two main objects of the act were the separation of the Port Phillip District from New South Wales, and the establishment in all the colonies of an improved system of provincial government. The Legislative Council, erected in New South Wales by the Act of 1842 was not materially disturbed. Its powers were in some respects increased, and the franchise on which its representative members were elected was liberalized.

The New Constitution.—A new election of members of the Legislative Council of New South Wales on the liberalized franchise then took place. The new council complained that the Act 13 and 14 Vic., c. 59, did not place the control of revenue taxation, and the waste lands of the Crown in the colonial legislature, and a full measure of local self-government in a Constitution similar in outline to that of Canada was applied for.

In 1852 gold was discovered in New South Wales and Victoria, which caused a great influx of immigrants into these colonies. In a despatch addressed to Governor Fitzroy, dated 15 Dec. 1852, Sir John Packington, Secretary of State for the Colonies, stated that Her Majesty's government had been greatly influenced by considerations arising from the extraordinary discoveries of gold in the Australian colonies, which had imparted new and unforeseen features to their political and social positions. It was the wish, therefore, of Her Majesty's government that there should be established in each colony a new legislature consisting of a Legislative Council nominated by the Crown, and an elective House chosen by qualified inhabitants. To such legislatures it was proposed to give general powers including that of dealing with the waste lands of the Crown.

Upon the receipt of this despatch the Legislative Council of New South Wales, under the authority conferred by 13 and 14 Vic., c. 59, s. 32, appointed a select committee to draw up a constitution establishing a bicameral legislature, having increased powers and functions. A constitution was accordingly drawn up. It provided that, in place of the Legislative Council then existing, there should be a Legislative Council and a Legislative Assembly, and that Her Majesty should have power by and with the advice and consen: of the said Council and assembly, to make laws for the "peace, welfare and good government of the said colony in all cases whatsoever." The members of the Council were to be nominated by the governor with the advice of the Executive Council. The first nominees were to hold their seats for five years only. The members of the Assembly were to be chosen by male electors having certain residential and property qualifications. An Assembly once constituted was to continue for five years unless dissolved by the governor. The new legislature was endowed with full power to deal with the waste lands of the Crown and to impose duties or customs.

On 21 Dec. 1853, the new Constitution was

adopted and transmitted to the Secretary of State for the Colonies. In an amended shape it was made a schedule to a bill introduced into the Imperial Parliament, entitled "A Bill to enable Her Majesty to assent to a bill as amended by the legislature of New South Wales to confer a Constitution on New South Wales." The bill was passed by Parliament and received the royal assent on 16 July 1855. Its number is 18 and 19 Vic., c. 54. The act conferring a constitution on Victoria was assented to on the same day. The constitutions were then transmitted to the respective colonies, accompanied by explanatory despatches from the Secretary of State, Lord John Russell, in which the governors were instructed as to the introduction of responsible government.

Responsible Government.— That great change in the colonial system of administration known as "The Introduction of Responsible Government"— that is of ministers appointed by and responsible to the governor, but constitutionally and practically responsible to Parliament — is said by some authorities to have been effected solely by despatches from the Secretary of State to colonial governors. These despatches described the circumstances in which the Crown, through the governor for the time being, would exercise its right of displacing one set of public servants and of appointing others in their places — that no change would be made so long as those public servants, being ministers in charge of departments, possessed the confidence of the local legislature. In the body of the Constitution Act of New South Wales (and this remark applies equally to that of Victoria) the words "responsible ministers" do not occur. Were it not for a marginal note to one of the sections, not even a hint would have been given on its face of the important change it was intended to effect.

Other constitutional jurists, however, affirm that section 37 of the Constitution Act of New South Wales, and the corresponding section of that of Victoria, contains provisions which assume if they do not originate some plan of ministerial and responsible government. Both those sections declared that appointments of all public offices shall be vested in the governor with the advice of the Executive Council, "except the appointment of officers liable to retire from office on political grounds which appointments shall be vested in the governor alone." The Constitution Acts of South Australia, Queensland and Western Australia contain substantially similar sections. But section 18 of the Constitution Act of Victoria and section 32 of the act of South Australia went much further in the direction of expressly recognizing and introducing responsible government. Those sections enacted that a certain number of officers of the governments in those colonies for the time being should be members of the legislature created by the new constitutions. On 22 May 1856, the first Parliament of New South Wales under the new Constitution was opened by Sir William T. Denison. The first responsible ministry had Mr. Alexander Donaldson as Colonial Secretary and Premier.

Administration and Legislation.—With the establishment of responsible government in New South Wales the initial pulsations of political life in Australia may fairly be said to date their beginnings. The governor of the colony was the representative of the Crown, but he was no longer his own Prime Minister. In 1859 a new Parliament was elected under the provisions of an Act to Amend the Constitution, introduced and passed by the advice of the Cowper administration, providing for increased electoral representation, vote by ballot and manhood suffrage which in later years was developed into "one man one vote," and finally into "one adult one vote."

In 1860 the Robertson Ministry introduced two land bills, one providing for the alienation and the other for the pastoral occupation of Crown lands. The main principles of these bills were free selection — before survey, which constituted the battle-cry of the land reformers, In 1861 the bills were again introduced into the Assembly, Mr. Robertson resigned his seat in the Assembly and was appointed a member of the Council in order to pilot the bills through that chamber. Both bills were again passed by the Assembly and sent to the Council. In order to counteract and overcome the opposition in the Council it was decided to swamp that chamber by the appointment of 21 members. A parliamentary crisis was thus brought about. A majority of the old members withdrew from the chamber, thus leaving it without a quorum and the fresh nominees could not be sworn in. The term of office of the first members of the Council was limited to five years, which was then about to expire. The Council was reconstructed by the appointment of 27 life members on 24 June 1861; Wentworth being appointed the first president. In 1862 the Crown land alienation bill and the Crown land occupation bill were passed by both Houses. A Chinese immigration restriction bill, embodying the main provisions of Victorian legislation, was also passed.

In 1863 Messrs. Dalley and Parkes returned to the colony from England, where they had been sent on a mission to promote emigration to New South Wales. From this time on Mr. Parkes became a prominent figure in the political world of New South Wales. He was closely identified with the cause of free trade. In 1868 Mr. Parkes resigned and temporarily withdrew from public life. The most notable public events of this period were the withdrawal of the British troops from New South Wales and Victoria, and the successful transmission of the first through cable message from Australia to England.

In 1872 the Martin-Robertson Ministry was defeated. Mr. Parkes having returned to the House was entrusted with the task of forming a ministry. He retained the premiership until 1875, when his government was defeated on the motion by Mr. Robertson. The Robertson Ministry remained in office until 17 Dec. 1877, when Mr. Parkes formed another ministry which had but a short reign. A political duel went on between Mr. Parkes and Mr. Robertson for a considerable time, but was at last terminated by a coalition of the two leaders who, in December 1878, formed a ministry which lasted until January 1883. In 1881 a Chinese immigration restriction act was passed imposing severe penalties on Chinese entering the colony without payment of a poll tax of £10. An act was passed legalizing trade unions. The Federal Council of Australia was created

on 28 Nov. 1883. A rich silver field was discovered at Broken Hill (1883).

The Land Bill of 1882 was the rock on which the Parkes-Robertson Ministry was wrecked. A general election resulted in Mr. (afterward Sir) Alexander Stuart coming to power which he held until October 1885. In 1888 another Chinese Restriction Act was passed. The poll tax was raised to £100 per head. Chinese were not permitted to engage in mining and they were not qualified to be naturalized. A tonnage limitation was imposed on vessels bringing Chinese to New South Wales; they were not allowed to bring more than one Chinese passenger to every 300 tons.

In February 1890, a Federal Conference, presided over by Sir Henry Parkes, was held in Melbourne, at which it was resolved that a National Australian Convention should be held to draft a constitution for the federation of the Australian colonies. In March 1891, the Convention was held in Sydney and a draft constitution was adopted. In October 1891, the last Parkes Ministry was defeated, being succeeded by that of Sir George Dibbs. In 1893 an Electoral Bill was passed embodying the principle of "one man one vote."

In August 1894, the Dibbs' Ministry, which had introduced protection in a modified form, gave way to a free trade ministry formed by George H. Reid. A new tariff on free trade lines, a land tax, an income tax, and homestead bills were passed under his leadership. Early in 1895 Mr. Reid attended a conference of premiers at Hobart at which the draft of an Enabling Bill to be introduced into the legislature of each colony, providing for the election directly by the people of each colony of 10 representatives to attend a Federal Convention to frame a constitution for the federation of the colonies, to be afterward submitted to a referendum of the people of each colony, was adopted. Subsequently the Parliament of New South Wales, as well as the Parliaments of the other colonies, passed identical bills for the aforesaid purpose. It was under the authority of this legislation that the Commonwealth Constitution was afterward framed and adopted. In 1897 an Immigration Restriction Act, based on the Natal Act, imposing an education test in order to exclude colored aliens, was passed. Legislation on similar lines was adopted in several other colonies.

On 13 Sept. 1899, the Reid Ministry was defeated and Sir William Lyne formed a government which succeeded in passing the Early Closing Act, the Navigation Act, the Old Age Pension Act, and the Women's Franchise Act. In March 1901, Sir William Lyne retired in order to take office as a Commonwealth Minister. The ministry formed by Mr. (afterward Sir) John See succeeded it. One of the most important measures passed through its instrumentality was the Industrial Arbitration Act (1901); under which the principle of compulsory arbitration and settlement of industrial disputes was established. A short-lived Waddell Ministry was followed by one formed by Mr. Joseph Hector Carruthers, who resigned on account of ill health and was succeeded by Mr. Wade who held office until October 1910 when he was defeated and Mr. McGowen became Premier until 30 June 1913 when he resigned and was succeeded by Mr. W. A. Holman who is still in office November 1916.

VICTORIA AN OFF-SHOOT OF NEW SOUTH WALES.

Separation.— By Act 13 and 14 Vic., c. 59 (5 Aug. 1850), the district of Port Phillip, bounded on the north and northeast by a straight line drawn from Cape Howe to the nearest source of the river Murray, and thence by the course of that river to the eastern boundary of the colony of South Australia, was separated from the colony of New South Wales, ceased to return members to the Legislative Council of such colony, and was erected into and thenceforth formed a separate colony, "to be known and designated as the colony of Victoria." A Legislative Council was created in and for the new colony having powers and functions similar to those of the newly-organized Council of New South Wales. On 1 July 1851, writs for the election of 20 elective members for the Legislative Council of Victoria were issued; 10 were nominated by the Crown. Mr. Latrobe was appointed lieutenant-governor. In this manner the colony of Victoria was called into existence and received the first impulse of an autonomous political life. The new Council was convened for the despatch of business in November 1851, at about the time when gold was being discovered in fabulous quantities in the famous goldfields of Ballarat and Bendigo. The official members were: Mr. W. Lonsdale, Colonial Secretary; Mr. (afterward Sir) W. F. Stawell, Attorney-General; Mr. (afterward Sir) Redmond Barry, Solicitor-General; C. H. Ebden, Auditor-General; and R. W. Pohlman, Chairman of the Court of Requests. J. F. Palmer was elected speaker.

The New Constitution.—A new constitution drawn on the same lines, and passed in the same manner as that of New South Wales, was assented to by Her Majesty on 16 July 1855. The only substantial difference between the two bicameral legislatures was that while the Legislative Council of New South Wales was composed of members nominated by the Crown the members of the Legislative Council of Victoria were elected by residential inhabitants having high property qualifications.

Responsible Government.— The premier of the first responsible government was W. C. Haines. The first election for the Legislative Assembly took place in the spring of 1856. The first ministry resigned on the passing of an unfavorable resolution upon the subject of the estimates, in March 1859. Sir John O'Shannassy, the mover of the resolution, then became Premier.

Administration and Legislation.—Among the problems which soon engaged the attention of the newly-created Parliament of Victoria were those of constitutional reform, manhood suffrage, land and mining legislation, agriculture, protection, and free trade, inter-colonial relations, public works, railways, telegraphs, water supply, immigration, Chinese immigration restriction, naval and military defense and education.

Among the first administrations which held office in Victoria were those of which William Clark Haines was Premier in 1855–57; 1857–58; Mr. (afterward Sir) John O'Shannassy, Premier, 1857; 1858–59; 1861–63; Wm. Nicholson,

Premier, 1859–60; Richard Heales, Premier, 1860–61.

In the early days of the goldfields great discontent existed because of the heavy license fee of 30 shillings per month which every digger was required to pay. In November 1854, the tyrannical policy of the government culminated in an open insurrection which broke out at Ballarat. A flag of revolt, having the emblem of the Southern Cross, was hoisted over a barricade known as the "Eureka Stockade." By command of Governor Sir Charles Hotham a force of British troops was sent to Ballarat to storm the stockade. Many lives were lost. After this tragic period,— the first and only bloodshed in Australia in the name and for the cause of political freedom,— the grievances of the diggers were redressed.

In 1855 the Legislative Council of the newly-created colony of Victoria led the way in the passage of a number of laws intended to restrict Chinese immigration, which commenced in 1854, when the fame of the gold diggings of Victoria began to attract thousands of Chinamen to that colony. The Victorian Council passed a bill, which was assented to by the governor, "to make provision for certain immigrants." The substance of the law was that no ship should bring to a Victorian port more passengers, being Chinese immigrants, than in the proportion of one person to every 10 tons of the tonnage of such ship, under a penalty of £10 for each passenger in excess of such proportion. On the arrival of a ship in any port of Victoria with Chinese immigrants on board, the master was required to pay to the collector of customs a tax of £10 for every such immigrant. The money so collected was to be invested by the government to form a fund for the relief, support and maintenance of such immigrants. Provision was made for the registration of such immigrants, on their arrival in any district or place to which they proceeded. This and other Immigration Acts were consolidated in 1865.

Another notable measure passed by the first Legislative Council of Victoria was a bill adopting "vote by ballot;" this was the first measure in the history of parliamentary government in which this method was made legal.

The first important bill was introduced by James Service as Commissioner of Crown Lands and Surveys in the Nicholson government, on 30 Nov. 1859. The chief feature in this bill was that of free selection for settlement and agriculture over all the waste land of the colony, subject to certain conditions with respect to lands not yet surveyed. The bill was passed by the Assembly but was rejected by the Council.

The period from 1863 to 1866 was memorable in the history of Victoria. It began in a conflict between the parties representing Protection and Free Trade. It then developed into a struggle between the two Houses for financial supremacy, and in its third and last stage it became a contest between the Legislative Assembly and the Crown. The first McCulloch Ministry took office in June 1863; it remained in power until 6 May 1868. One of its first proposals was a bill imposing numerous customs duties of a protective character. It was passed by the Lower House and rejected by the Council. It was then reintroduced tacked on to the Appropriation Bill. The Council again rejected it, and a deadlock ensued. The government in the meantime collected duties on the authority of the Assembly alone. Funds not having been voted for payment of the public service the government borrowed money to the amount of £40,000 from the London Chartered bank which then sued the government for money lent. The government confessed judgment. The Supreme Court pronounced the collection of customs duties on the resolution of the Assembly to be illegal. It also held that confessed judgments against the Crown were illegal. A tariff, separated from the Appropriation Bill, was again passed by the Assembly and again thrown out by the Council. The ministry resigned. Mr. Fellows formed a government which, however, could not carry on. Mr. McCulloch returned to office and the Tariff Bill was again passed by the Assembly, and again sent up to the Council. The preamble of the bill asserting the exclusive right of the Assembly to grant money and taxes was eventually withdrawn, and the bill was passed.

The second McCulloch Ministry was defeated on 20 Sept. 1869. It was followed by an administration formed by John Alexander McPherson which remained in office for six months. It was displaced on 9 April 1870, by Sir James McCulloch, who, on 19 June 1871, was defeated on his property tax proposals. Charles Gavan Duffy then formed a ministry which successfully proposed and carried a protectionist tariff. The Duffy Ministry was defeated on 10 June 1872. The governor refused a dissolution and James Goodall Francis became Premier. The first Mining on Private Property Bill was carried in the Assembly by 43 votes to 3, but was rejected by the Upper House. A bill to regulate mines, in order to prevent mining accidents, and to protect miners, was passed.

In 1875 the Kerferd government introduced a bill imposing certain duties on wines and spirits. The tariff proposals were carried by a majority of one. This the government accepted as an adverse vote and applied for a dissolution, which the governor refused. On 7 Aug. 1875, Graham Berry formed his first ministry, but he was defeated on 20 Oct. 1875. Sir James McCulloch's fourth and last government then came into power. Its accession marked the beginning of a stormy and momentous political period. The Berry party raised a "stone wall" of obstruction, and the McCulloch party retaliated by passing standing orders to restrict and limit debate, which became known as the "Ironhand" and the "Gag." The McCulloch Ministry became very unpopular throughout the country. At a general election held on 11 May 1877, an immense majority was returned against the government. Mr. Berry then formed his second ministry. The principal planks in its program were, a land tax to "burst up the large estates," and payment of members. A Land Tax Bill was introduced and passed. Provision for the payment of members, to the amount of £300 per year, was made in the Appropriation Bill. In that form it was sent to the Council where it was rejected on the ground that it was a "tack." Then ensued the historic deadlock of 1877–78. No money having been voted to pay the public servants the government on 8 Jan. 1878, ordered the dismissal of

all heads of departments, County Court judges, police magistrates and other public officers. This proceeding caused a great sensation, and by the opponents of the ministry it was denounced as "revolutionary." Shortly afterward a compromise was arrived at: payment of members was passed in a separate bill and the Appropriation Bill without the obnoxious "tack" was carried. The Berry party then devoted their attention to the question of constitutional reform. A bill was passed through the Assembly providing for the adoption of a method of referendum to settle disputes between the two Houses. It was rejected by the Council. A deputation, or embassy, consisting of the Premier and Professor Pearson, was sent to England to interview the Secretary of State for the Colonies, who was asked to settle the constitutional difficulty in Victoria. Sir Michael Hicks-Beach gave a very guarded reply stating that the Imperial Parliament would never alter the Constitution of the colony at the instance of one House only.

In 1879 the Parliament of Victoria again resorted to legislation in order to arrest the influx of Chinese. Vessels were not allowed to introduce into any Victorian port more than one Chinaman per 100 tons of tonnage, and a poll tax of £10 was imposed on each immigrant on his landing. In April 1888, a Chinaman, Chun Toy, arrived in the port of Melbourne on board the British ship *Afghan*. The collector of customs considered that the *Afghan* had brought a larger number of Chinese than was allowed by law; he refused to allow any of them to land, or to accept the poll tax of £10 each. Chun Toy brought an action against the collector in the Supreme Court of Victoria, which decided that the action of the government in preventing the landing of the Chinese prepared to pay the prescribed poll tax was illegal. The Victorian government appealed from this decision to the Privy Council which reversed the judgment of the Victorian court, and held (1) that the collector of customs was under no legal obligation to accept payment whether tendered by the master on behalf of any such immigrant, or tendered by or for any individual immigrant; (2) that, apart from the act, an alien has not a legal right, enforceable by action, to enter British territory.

After an appeal to the constituencies in March 1880, Berry resigned, and James Service then formed a ministry. He introduced a measure to amend the Constitution, which upon a division was lost by two votes. Parliament was dissolved and a general election was held in June 1880, which resulted in the Berry party being returned to office with a substantial majority. The principal work done by the third Berry Ministry was the carrying of a bill to amend the constitution of the Legislative Council by reducing the qualification of electors and of members. A bill was also passed making permanent provision for payment of members. In July 1881, the third Berry Ministry was succeeded by one formed by Sir Bryan O'Loughlin. The O'Loughlin ministry lost office in March 1883, when a coalition ministry under Service and Berry was formed. Under this government, acts were passed for the abolition of political control of the government railways by placing them under the management of three independent commissioners, and for the abolition of patronage in the public service. During his premiership, Service took great interest in the question of Australian Federation, and through his instrumentality a convention was held in Sydney at which a scheme for the establishment of a Federal Council was adopted.

The Service-Berry Ministry was followed in February 1886, by the Gillies-Deakin combination. In 1888 another Chinese Immigration Restriction Act was passed providing that no vessel should enter any Victorian port having on board more than one Chinaman for every 500 tons of the tonnage of such vessel. Any Chinese who should enter Victoria by land, without first obtaining a permit in writing, from some person to be appointed by the governor in Council, was declared guilty of an offense against the act, and made liable on conviction to a penalty of not less than £5 nor more than £20 and also, upon the warrant of the commissioner of trade and customs, to be removed or deported to the colony from whence he came.

On 5 Nov. 1890, the Gillies-Deakin Ministry was succeeded by a ministry formed by James Munro, who in his turn gave place in February 1892, to one formed by William Shiels. The careers of the Shiels Ministry, the Patterson Ministry and the early part of that of the Turner Ministry, which came into office on 27 Sept. 1894, were comparatively uneventful. In February 1895, Sir George Turner was associated with Reid and other premiers in a conference held at Hobart at which a Federal Enabling Bill was drafted. The first Turner Ministry was defeated in December 1899. Allen McLean's Ministry held office for a little over 11 months; during which time several contingents were sent from Victoria to assist the British army in South Africa. On 15 Nov. 1900 Sir George Turner again became Premier in time to make arrangements for the establishment of the Commonwealth. An Old Age Pension Act was passed, also bills protecting the rights and interests of Victorian public servants. In the beginning of 1901 Sir George Turner resigned the premiership and accepted office as Treasurer in the first Federal Cabinet. Sir Alexander Peacock became head of the new government. On 3 June 1902, the Peacock Ministry was displaced on a no-confidence motion by Mr. (now Sir) W. H. Irvine. During the career of the Irvine Ministry a railway strike occurred in Victoria which resulted in an act being passed for the separate representation in Parliament of railway and other public servants. On the retirement of Irvine he was succeeded by Thomas Bent who resigned and was succeeded by John Murray, who held office until May 1912, when he was succeeded by Mr. W. A. Watt, who resigned on 9 Dec. 1913. When Mr. G. A. Elmslie formed a labor ministry which was defeated by Mr. Watt who again resumed office 22 Dec. 1913. Mr. Watt resigned to enter the Federal Parliament in June 1914 and was succeeded by Sir A. J. Peacock, who still holds office (November 1916).

TASMANIA AN OFF-SHOOT OF NEW SOUTH WALES.

Separation.—By the Act 4 Geo. IV, c. 96 (19 July 1823), the Crown was empowered to separate Van Diemen's Land from New South Wales, and erect it into a separate colony which then received a lieutenant-governor, an Executive Council and a small Legislative Council,

consisting of seven members. By Act 13 and 14 Vic., c. 59, s. 7, it was provided that the legislature already existing in Van Diemen's Land might establish within the colony a Legislative Council to consist of not more than 24 members, of whom one-third should be nominated by Her Majesty and the remainder elected by qualified inhabitants of the colony. Under the authority of this law a new Legislative Council was called into existence having powers and functions similar to the Legislative Council of New South Wales.

The New Constitution.— During the governorship of Sir William Denison the new Legislative Council of Van Diemen's Land under the powers conferred by 13 and 14 Vic., c. 59, s. 32, drafted a constitution for the establishment of a bicameral legislature in Van Diemen's Land composed of a Legislative Council of 15 members elected by the qualified inhabitants, and a House of Assembly of 30 members elected on a more popular franchise than that of the Council. The bill so drawn was passed by the Legislative Council and reserved by the lieutenant-governor for the Royal assent. It became law on 24 Oct. 1856; the first Parliament being opened on 2 Dec. 1856. Sir Henry E. F. Young was appointed the first governor-in-chief of the colony under the new system of responsible government. The first premier was William T. N. Champ. In the year 1853, upon the cessation of transportation, the name of the island was changed from that of Van Diemen's Land to Tasmania.

Administration and Legislation.— Upon the cessation of transportation and the grant of responsible government to Tasmania a new life and destiny was imparted to the struggling community. Between 1855 and 1872 there was substantial improvement and progress in the position and prospects of the island, marked by the development of the interior, the construction of roads and tramways, the initiation of railway and telegraphic communication, the expansion of the agricultural and pastoral industries, the division of the colony into municipalities, the laying of a submarine cable between Tasmania and the mainland, the discovery of tin at Mount Bischoff and other places, gold in the quartz reefs at Brandy Creek and subsequently of silver and lead at Zeehan, and gold and copper at Mount Lyell. The west coast became famous by the opening up of some of the richest silver lead mines in the world; coal seams were opened at Hastings, Langlock and Ivanhoe.

In February 1894, while the Dobson Ministry was in office, the necessity of financial reform became a burning question. Financial proposals were submitted by the government. A bill to authorize a graduated land tax was submitted to the Assembly and rejected; consequently Dobson and his colleagues resigned in April 1894, and Sir Edward Braddon formed a ministry. An income tax was passed, together with a land tax imposing one penny per pound on the capital value of all land in the colony. This general tax was adopted as a sort of a compromise instead of the proposed tax on the unimproved capital value of the land which was at first submitted and rejected.

In February 1895, a conference of premiers was held at Hobart at which the draft of a Federal Enabling Bill was adopted. At a general election held in 1897, a system of voting based upon Hare's preferential method was used for the first time. During the year a Federal referendum was held at which a large majority of votes was given in favor of the Federal Constitution. In 1899 the Braddon Ministry was defeated and it was succeeded by one formed by Sir Niel Elliot Lewis on 12 Oct 1899, who retained office until 8 April 1903. On 9 April 1903, William Bispham Propsting became Premier, and on 12 July 1904 he was succeeded by John William Evans, who resigned and was succeeded by Sir Niel Elliot Lewis, who held office until June 1912 when he was succeeded by Mr. A. E. Solomon who was defeated by Mr. John Earle in April 1914, who held office until April 1916 when he was succeeded by Mr. W. H. Lee.

QUEENSLAND AN OFF-SHOOT OF NEW SOUTH WALES.

Separation.— On 6 June 1850, letters patent were issued erecting the Moreton Bay district into a separate colony, under the name of Queensland, and appointing Sir George Ferguson Bowen to be captain-general and governor-in-chief thereof. The boundary of the new colony was defined as a line commencing on the sea coast at Point Danger, in latitude about 28° 8′ S., running westward along the Macpherson and Dividing Ranges and the Dumaresq River, to the McIntyre River, thence by the 29th parallel of S. latitude to the 141st meridian of E. longitude from the 29th to the 26th parallel, and thence the 138th meridian north to the Gulf of Carpentaria, together with all the adjacent islands, their members and appurtenances in the Pacific Ocean. The governor was authorized to appoint an Executive Council to advise and assist him in the government of Queensland. The Constitution of Queensland was embodied in an Order in Council bearing the same date as the letters patent.

The New Constitution.— The Order in Council provided that there should be within the colony of Queensland a Legislative Council and a Legislative Assembly, with the advice and consent of which Her Majesty should have power to make laws for the peace, welfare and good government of the colony in all cases whatsoever. In its main outlines the Constitution of Queensland was almost a replica of that of New South Wales. The first Parliament under the new Constitution was convened for the despatch of business on 29 May 1859.

Administration and Legislation.—Public events in Queensland became clustered around and associated with the following prominent men who held office as Premiers between 1859 and 1899: Robert G. Herbert, Arthur MacAlister, Robert MacKenzie, Charles Lilley, Arthur Palmer, George Thorn, John Douglas, Thomas McIllwraith, Samuel Griffith, Boyd D. Morehead, Hugh Muir Nelson, Thomas J. Byrnes and James R. Dickson.

From the date of separation Queensland began to advance with rapid strides, and it soon occupied a prominent position in the Australian group. Between 1861 and 1871, under a policy of assisted immigration, the population largely increased and the resources of the country were developed in the direction of pastoral and agricultural pursuits, gold and silver mining, sugar and cotton growing. Cotton growing was stim-

ulated by bounties. The pastoral industry was promoted; railway construction was commenced; state aid to religion was withdrawn and a system of primary and secondary education was initiated. Queensland was found to be particularly suitable for sugar growing and a demand for cheap labor quickly sprang up. In course of time shiploads of South Sea Islanders were introduced by the sugar planters and it was soon found necessary for the legislature to interfere.

A financial crisis occurred in 1865, which in 1866 resulted in a change of ministry. The first MacAlister Ministry had a short term of office. Herbert was again called to the helm of affairs but in a few months he was again displaced. The second MacAlister Ministry lasted for 12 months and eight days. It secured the passing of an important measure dealing with the cultivation and occupation of Crown lands. It was followed by the MacKenzie Ministry and the Lilley Ministry. The MacKenzie Ministry of 1867 introduced and passed a Crown Land Act which gave greater facilities for settlement. The Lilley Ministry of 1868 passed acts relating to the civil service, court procedure, and electoral laws. The Lilley Ministry was followed by the Palmer Ministry which lasted from 3 Jan. 1870 to 8 June 1874. In 1875 during the reign of the third MacAlister administration a State Education Act was passed which embodied the principles of free, secular and compulsory education. A complete measure of local government was passed in 1878, under the rule of the Douglas administration. In the same year the first act to restrict Chinese immigration into Queensland became law.

In 1879, Mr. (afterward Sir) Thomas McIllwraith formed his first government. On 4 April 1883, he made a dramatic and sensational attempt to annex New Guinea, directing H. M. Chester, at Thursday Island, to cross Torres Straits and on behalf of Her Majesty's government in Queensland to hoist the British flag and proclaim the annexation to that colony of that part of the island not claimed by the Dutch. This act was repudiated by Lord Derby, who, however, on 10 Oct. 1884 declared a British protectorate over the southern part of the island; Germany seized the remainder.

In November 1883, McIllwraith was defeated and Mr. (afterward Sir) Samuel Griffith succeeded him. During his term of office a convention of Australian representatives was held in Sydney, at which a scheme for the establishment of a Federal Council of Australasia, drafted by Griffith, was adopted and it afterward became law by Imperial legislation. A Crown Lands Act was passed by the Griffith administration in 1884. It encouraged Crown tenants to improve their holdings, facilitated bona-fide settlement and discouraged the speculative acquisition of land. The first Griffith Ministry was succeeded (13 June 1888) by the second McIllwraith government, which had only a brief tenure of office, being on 20 Nov. 1888, supplanted by the Morehead Ministry which lasted until 7 Aug. 1890. The second Griffith Ministry was then formed. In April 1891, Griffith took an active part in a Federal convention held in Sydney at which a draft constitution for the union of the Australian colonies was adopted.

The Kanaka labor question became important about this time and the Griffith Ministry advised the reintroduction of Polynesian laborers. On 14 April 1892, the Pacific Laborers' Extension Bill was passed, notwithstanding strong objections urged against the introduction of colored races into Queensland. On 11 Jan. 1893, Griffith was appointed chief justice. Mr. (afterward Sir) Hugh Muir Nelson occupied the post of acting Chief Secretary pending the arrival from England of Sir Thomas McIllwraith who, on 27 March, became Premier of his third and last administration. In October following he resigned the premiership in which he was succeeded by Sir Hugh Muir Nelson. In 1894 the great strike of shearers occurred in Queensland, leading to a reign of lawlessness which resulted in the passage of the Peace Preservation Act. In 1896 a Meat and Dairy Produce Act was passed which gave a stimulus to the primary industries. Increased facilities for land settlement were offered.

On 13 April 1898, Sir Hugh Nelson resigned the premiership and was appointed president of the Legislative Council. The task of forming a new government was entrusted to T. J. Byrnes who gave promise of a brilliant political career which was cut short by his death at the early age of 36, after five months of office. Mr. (afterward Sir) James R. Dickson then became Premier. He was an ardent Federalist and exercised the power of his influence in favor of Queensland joining the Commonwealth which was then on the eve of being established. He represented Queensland at a conference of premiers at which the Constitution, as adopted by the Convention, was slightly modified. In September 1899 the Constitution was submitted to the people of Queensland by a referendum and was approved by a large majority. In December 1899, a Labor Ministry was formed by Anderson Dawson; it lasted six days and R. Philp, a former colleague of Dickson, then formed a ministry. Philp held office until 17 Sept. 1903. The Labor party, having in the meantime increased in members and influence, became sufficiently strong to take a share in the executive government of the country, and accordingly Arthur Morgan vacated the speaker's chair and formed a Liberal Labor government in which the Liberals and Laborites were equally represented. In January 1906, Morgan resigned the premiership and became vice-president of the Executive Council, William Kidston, leader of the Labor party, becoming Premier, a position he held until February 1911, when he was succeeded by Mr. D. F. Denham, who held office until 1 June 1915, when he was defeated by Mr. T. J. Ryan who formed a labor government.

WESTERN AUSTRALIA THE SECOND ORIGINAL COLONY.

Foundation.—The first Imperial Act applicable to Western Australia was 10 Geo. IV, c. 22 (1829). It was entitled "An Act to Provide Until the 31st Day of December 1834, For the Government of His Majesty's Settlements in Western Australia on the Western Coast of New Holland." It will be noticed that the name "Australia" first suggested for the continent in 1814 by Matthew Flinders is here used and for the first time mentioned by

an Imperial Act. By that act the king, with the advice of the Privy Council, was empowered to authorize any three or more persons resident within the settlements to make, ordain and constitute laws, institutions and ordinances for the peace, order and good government of His Majesty's subjects and others within the settlement.

A Representative Legislature.— Under the Act 13 and 14 Vic., c. 59 (5 Aug. 1850), Western Australia was granted a Legislative Council, consisting of 26 members, nine of whom were nominated by the Crown and 17 were elected by qualified inhabitants. Three years afterward an agitation was commenced in favor of responsible government as it existed in the eastern colonies. In 1874, a draft of a Constitutional Bill was sent to the Secretary of State, who, however, decided that the colony was not yet ripe for the change.

The New Constitution.— The movement was not successful until July 1890, when a new Constitution was passed by the Imperial Parliament, being embodied in the Act 53 and 54 Vic., c. 26. It created a bicameral legislature consisting of a nominee Council and an elective Assembly to make laws in and for Western Australia, and along with it responsible government was introduced. The first Premier was Sir John Forrest.

Administration and Legislation.— The discovery of goldfields and a rapid influx of population were factors which largely contributed toward the success of the constitutional movement. The new Parliament was called upon to pass legislation relating to gold mining, land settlement, railway construction and water supply. Under the old régime a railway 243 miles long had been constructed on the land grant system between Beverly and Albany. Under the terms of the contract, payment was made at the rate of 12,000 acres for every mile of completed road. The lands selected in payment were situated within a belt of 40 miles on each side of the line; half the frontage to the railway was reserved to the government. In 1896 the government acquired this private land-grant railway, the purchase price being £1,100,000. The Perth waterworks constructed by the Perth Water Supply Company were taken over by the government at a cost of £220,000. Among the lines of railways which greatly assisted in the development of the interior were the lines to Kalgoorlie, Menzies and Kanowna, penetrating into the heart of the eastern goldfields. A gigantic scheme of water supply for the conveyance of water through pipes by pumping from station to station, from the Mundaring Reservoir to Coolgardie and Kalgoorlie, a distance of 330 miles at a cost of £2,500,000, was inaugurated, and afterward successfully completed.

In 1897–99 the question of federation came into prominence. The attitude of the Forrest government toward the new constitution was not favorable whilst on the gold-fields there was a strong movement in favor of the bill backed up by threats of separation. This led to a change of attitude on the part of the government, and at the test referendum that followed a majority of electors voted in favor of Federal union.

In 1899 an Electoral Bill was passed which conferred the political franchise on adult women; it was exercised for the first time on the occasion of the Federal referendum.

Sir John Forrest retired from state politics in February 1901, and G. Throssell succeeded him as Premier. The Throssell Ministry was defeated at a general election held the same year. George Leake then formed a ministry which was short-lived, as also was another formed by Alfred Edwards Morgans. On 23 Dec. 1901 Leake formed his second ministry and held office until his death on 24 June 1902. He was succeeded in the premiership by Walter H. James on 1 July 1902. The only notable matters of legislation passed in this period of short-lived ministries were the Arbitration and Conciliation Act and the Workmen's Compensation Act. On 10 Aug. 1904 James was defeated and a Labor ministry was formed by Henry Daglish. It remained in office until 25 Aug. 1905 when it was displaced — partly by dissension within the ranks of the Labor party, and ostensibly on the question of purchasing and resuming possession of the Midland Railway. On 25 Aug. 1905 Cornthwaite Hector Rason became Premier of a Liberal administration, pledged to oppose the extreme policy of the Labor party. He secured a dissolution and went to the country from which he returned with a strong working majority. He resigned in May 1906, to accept the position of agent-general in London and Mr. (now Sir) Newton James Moore became Premier and he held office until September 1910 when he was succeeded by Mr. Frank Wilson who was defeated by the Labor party in October 1911 and Mr. John Scadden became Premier, until July 1916 when he was defeated by Mr. Frank Wilson.

SOUTH AUSTRALIA THE THIRD ORIGINAL COLONY.

Foundation.— This province was originally carved out of that part of the colony of New South Wales lying between the meridians 132° and 141° E. longitude, bounded on the north by the 26° parallel of S. latitude and on the south by the Southern Ocean. This region was never occupied, or settled, by the New South Wales government. On 15 Aug. 1834, the Act 4 and 5 Wm. IV, c. 95, entitled "An Act to empower His Majesty to erect South Australia into a British Possession or Province, and to provide for the Colonization Thereof" was passed. It did not purport to separate the territory from New South Wales; it seemed to contemplate the whole of that part of the continent as not being subject to any prior statutory authority. It empowered the King to appoint a governor and colonization commissioners, who were to have the control of the Crown lands, with power to survey and sell the same, and to employ a portion of the money so derived in conducting the immigration of laborers from Great Britain. In the exercise of these powers the province was erected; a governor, a judge, seven commissioners and other officials were appointed. The governor, with the concurrence of the chief justice, the colonial secretary and advocate-general, or two of them, was authorized to make laws and impose taxes. Captain (afterward Sir) John K. Hindmarsh was appointed the first governor.

On 28 Dec. 1836, Governor Hindmarsh arrived at Glenelg and proclaimed the establishment of the government. He was succeeded on 12 Oct. 1838, by Governor Gawler, during

whose term of office the settlement became involved in debt to the extent of £281,842. Gawler was recalled (May 1841), and a radical change was made in the government of the colony; the office of Colonization Commission in London was abolished; South Australia was made a Crown colony, the government was vested in the Secretary of States for the Colonies. Captain (afterward Sir) George Grey was appointed governor, and almost absolute power was entrusted to him.

In 1842 the Act 5 and 6 Vic., c. 61, entitled "An Act to provide for the better government of South Australia" was passed. Under it a nominated Legislative Council, consisting of the governor and seven other persons resident in the colony, was created, having power to make laws for its government. On 25 Oct. 1845, Captain Grey was transferred to New Zealand, and Lieutenant-Colonel Robe acted as governor for a short time. His successor was Sir Henry Fox Young, to whom the colony was indebted for an extensive main road system, and the institution of local government in the shape of district councils.

A Representative Council.— Under the Act 13 and 14 Vic., c. 59 (5 Aug. 1850), the Legislative Council then established in South Australia was authorized to establish another Legislative Council consisting of not more than 24 members, one-third of whom were to be appointed by the Crown and the remainder were to be elected by the qualified inhabitants. This new Council was authorized to make laws for the peace, order and good government of the province and to impose rates and taxes. On 21 July 1851, this Council consisting of 24 members was duly constituted.

The New Constitution.— In 1853 the Legislative Council of South Australia, in pursuance of powers conferred by section 32 of the Act 13 and 14 Vic., c. 59, passed a bill to establish a bicameral legislature for South Australia, consisting of a Legislative Council and a House of Assembly. This bill was reserved for the Queen's assent but it was disallowed. Subsequently a second bill to create a bicameral legislature was introduced in the Council and passed. It provided for the creation of two elective Houses to take the place of the Council created by the Act 13 and 14 Vic., c. 59. This bill eventually received the Royal assent, and is sometimes called the "Constitution Act" of South Australia. It contained provisions and machinery somewhat similar to the Constitution Act of Victoria. The suffrage for the Assembly was manhood coupled with registration and residence. Both Houses were chosen by ballot which was adopted on the motion of Francis S. Dutton, afterward Premier.

Responsible Government.— The election of members of the two new Houses took place in March 1857. The first session of the new Parliament commenced on 22 April 1857, during the governorship of Sir Richard Graves McDonnell. The first Premier was B. T. Finniss.

Administration and Legislation.—Among the public men of South Australia, who, in the early history of the colony under responsible government, took an active and prominent part in the great business of administration and legislation were the following who held office as Premiers from 1856 to 1870; Lieutenant-Colonel Boyd Travers Finniss, John Baker, Robert Richard Torrens, Richard Davies Hanson, Thomas Reynolds, George Marsden Waterhouse, Francis Stokes Dutton, Henry Ayers, John Hart, Arthur Blyth and Henry Bull Templar Strangways.

Mr. (afterward Sir) R. R. Torrens took office in 1857. His name has become famous by association with an act simplifying the transfer, conveyance and registration of land. Torrens was the originator of the plan; it was based on practical knowledge obtained by him as collector of customs, but he was assisted by the legal knowledge of Dr. Hubbe. The Torrens' Land Act system was afterward adopted by all the other Australian colonies. In 1861 a strip of territory lying between latitude 129° and 132° E. longitude and south of the 26° S. latitude known as "No Man's Land" was added to South Australia.

Sir Dominic Daly succeeded Sir Richard G. MacDonnell on 4 March 1862. In March 1863 an intercolonial conference was held in Melbourne at which the majority of the Australian colonies were represented. This conference was originated in a suggestion made by Sir Dominic Daly. It was resolved that it was desirable to settle the basis for a uniform tariff for the Australian colonies. No practical results followed the conference, but it foreshadowed the necessity of some form of Federal Union. In the same year the Northern Territory was added to South Australia by letters patent.

In 1868–69, a ministry, of which Henry B. Templar Strangways was Premier, held office. Its career was distinguished by the passing of a Land Act which was intended to promote settlement and prevent the monopolization of the large tracts of land by land sharks and dummies. Sale of land by auction was limited. Land was sold to bona-fide selectors on credit, the payments being allowed to extend over a period of four years, and no selector was allowed to take up more than 640 acres.

The great overland telegraph line from Port Augusta to Port Darwin, the construction of which was prosecuted during the premierships of Strangways, John Hart and Sir Arthur Blyth, was completed on 2 Aug. 1872. In 1875–76 a strong administration formed by Mr. (afterward Sir) James Penn Boucaut, was in power; it introduced a policy of internal development, public works and railways. It was proposed that a loan of £3,000,000 should be raised, coupled with increased taxation, stamp tax and probate duties. This scheme was passed by the Assembly and rejected by the Council. Mr. (afterward Sir) John Colton formed a ministry which adopted Boucaut's policy and carried his scheme of public works and railways without the increased taxation. In 1877 Boucaut's second ministry was in office, and during that year the overland telegraph line between Adelaide and Perth was completed.

The second Boucaut Ministry was succeeded by administrations of which the following were Premiers from 1878 to 1916: William Morgan, John Cox Bray, John Colton, John W. Downer, Thomas Playford, John Alexander Cockburn, Frederick William Holder, C. C. Kingston, Vaibeu Louis Solomon, J. G. Jenkins, Richard Butler, Thomas Price, A. H. Peake, John Verran and Crawford Vaughan.

In 1886 the jubilee of South Australia was

celebrated. C. C. Kingston came into power in 1893. A Crown Lands Consolidation Act was passed by his ministry which restricted the sale of Crown lands by auction, introducing a system of leasing country lands, coupled with the right of purchase and provided perpetual leases for agricultural purposes. Small blocks not exceeding the unimproved value of £100 were thrown open for lease on the application of workingmen. Personal residence on a block was necessary, either by the lessee or by his wife or children. The rent of each lease was notified in the *Gazette*. These lots were not subject to a revaluation, but were liable to land tax. In 1894 a bill was passed conferring the franchise on women. In order to give encouragement and to grant assistance to the farmers an Advance to Farmers' Act was passed in 1896, under which a state bank has been established in South Australia with power to grant loans to farmers at a low rate of interest with extended time for repayment of the principal.

On 25 April 1896, a general election was held in South Australia at which women exercised their right to vote; about 66 per cent of the women whose names were enrolled recorded their vote. On 22 Jan. 1897, Sir Samuel J. Way, chief justice of South Australia, was appointed a member of the Judicial Committee of the Privy Council. On 22 March the Federal Convention held its first session at Adelaide, at which the first preliminary draft was prepared. Mr. Kingston being defeated 1 Dec. 1899, resigned, and V. L. Solomon formed a ministry which was defeated on 7 December. F. W. Holder then became Premier. An Early Closing Act and a Workmen's Compensation Act were passed. In May 1901, Holder resigned in order to accept office in the Federal Parliament. He was succeeded in the premiership by J. G. Jenkins, who held office in the Playford, Kingston and Holder cabinets. He undertook the difficult task of carrying constitutional amendments rendered necessary by the adoption of the Federal Constitution transferring certain powers, functions and departments from the state to the Federal government. He succeeded in carrying a measure reducing the number of responsible ministers, reducing the number of members of the Assembly from 54 to 42, and reducing the number of the Council from 24 to 18. He resigned on 1 March 1905, and accepted the appointment of agent-general for South Australia in London. A ministry of which Richard Butler was Premier then took office. A general election took place in May at which Butler's party was defeated and on 20 July he resigned, and was succeeded as Premier by Thomas Price who died in 1909 and was succeeded by A. H. Peake whose party was defeated at the elections in April 1910 by the Labor party, and its leader, J. Verran, became Premier in June 1910, and held office until 17 Feb. 1912, when he was defeated by Mr. A. H. Peake who held office until 3 April 1915, when he was defeated by the Labor party and Mr. Crawford Vaughan became Premier.

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SIR JOHN QUICK,
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5. THE COMMONWEALTH, ITS CONSTITUTION, GOVERNMENT AND ADMINISTRATIVE DEPARTMENT.

The Beginning of the Federal Movement Toward Political Union.— Under the Acts of 63 and 64 Vic., c. 12 (1900) known as the "Commonwealth of Australia Constitution Act," the people of New South Wales, Victoria, South Australia, Queensland, Tasmania and Western Australia were united in a Federal Commonwealth under the name of The Commonwealth of Australia; and the old colonies, under the name of states, were declared to be parts of the Commonwealth. This great act marked the completion and consummation of a movement in favor of Australian federation, which extended over a period of nearly 60 years.

In 1847, Earl Grey, Secretary of State for the Colonies, proposed to create a separate legislature in and for Australia in which all the colonies then in existence should be represented, and which should have power to make laws in matters of common concern. In 1849, the Privy Council proposed that there should be a General Assembly having power to deal with custom duties, postal matters and to create a Supreme Court of Appeal. In 1853 a committee of the Legislative Council of New South Wales recommended the establishment of a General Assembly. All these proposals, however, were regarded as premature. The following is a summary of other unsuccessful efforts in the same direction; (1857) a select committee of the Victorian Legislative Assembly agreed that "the time for union had come"; in the same year a select committee of the New South Wales Parliament passed a similar resolution; (1860) a select committee of the Victorian Assembly recommended negotiation; (1862) the Colonial Secretary of South Australia commenced correspondence with other colonies urging that a uniform tariff was indispensable; (1863) tariff conference in Melbourne; (1865) inter-colonial conference at Sydney resulting in agreement by which the Murray border was made free of fiscal restriction; (1867) inter-colonial conference in Melbourne in reference to ocean postal service to Australia at which Sir Henry Parkes said: "the time has arrived when the colonies should be united"; (1880) inter-colonial conference in Melbourne at which a resolution was passed that "a Federal Council was needed to deal with the question of inter-colonial interest"; (1883) inter-colonial conference at Sydney at which the necessity of a Federal Council was affirmed, and at which a draft bill was adopted which afterward became law (this council, however, was not a success as only three of the colonies joined it); (1890) Federal conference in Melbourne convened by Sir Henry Parkes at which resolutions were passed affirming the necessity for an early convention of the representatives of all the colonies to prepare a scheme for a Federal constitution.

Convention of 1891.— On 22 March 1891, the first Federal convention was held in Sydney at which all the Australasian colonies, including New Zealand, were represented by seven delegates chosen by the Parliament of each colony. A constitution was drafted and adopted by the convention, but no practical action was taken to give it effect. In January 1895, a conference of premiers was held at Hobart, at which all the Australasian colonies were represented. It was resolved that "A convention consisting of 10 representatives from each colony, directly chosen by the electors, be

charged with the duty to frame a constitution; that the constitution so framed be submitted to the electors for acceptance or rejection by direct vote." Five of the six colonies, viz., New South Wales, Victoria, South Australia, Tasmania and Western Australia elected 10 representatives. Queensland did not take part in the convention which met in Adelaide in March 1897. C. C. Kingston, then Premier of South Australia, was elected president of the convention, which afterward sat in Sydney and Melbourne. A constitution was drafted, subsequently submitted to the people of the various colonies, and ratified, Queensland coming in at the last moment. The constitution so drafted and ratified by the people of Australia was afterward embodied in an Imperial Act, came into force and the Commonwealth was proclaimed.

The Federal Constitution.— The Federal Constitution came into force and the Australian colonies were united on 1 Jan. 1901. By this Constitution instrument a new Parliament was called into existence, as well as a new executive, and a new judiciary. The union of people and states, so organized and constituted, in many respects resembles that of the United States of America. The new form of government has been created for special and limited purposes to deal with matters of common Australian interests. The power and authority of the Federal Parliament, and Federal government, are limited and restricted to such powers and authorities as have been expressly taken from the state, or such new powers as are specified and particularized in the instrument. The governments and Parliaments of the states have the same legislative and executive scope as before — save as to matters delegated to the Federal authority. In this respect the Australian Constitution differs from that of Canada, which limits and defines the power of the province and confers upon the Dominion Parliament all the residue of sovereign power.

Executive Department of the Commonwealth.— The executive power of the Commonwealth is vested in the king, and exercised by the governor-general as the king's representative. It includes the maintenance of the constitution and the execution of the laws of the Commonwealth. There is an Executive Council to advise the governor-general in regard to the government of the Commonwealth. The governor-general can appoint ministers to preside over the several departments. No minister can hold office longer than three months, unless he be a member of the Senate or of the House of Representatives. There can be no more than seven ministers in office at the same time. The sum of £12,000 per annum is appropriated to be divided among ministers by themselves.

Immediately upon the establishment of the Commonwealth the departments of customs and excise in all states were by operation of law taken from the states and transferred to the Commonwealth. By proclamation later on the departments of post-offices, telegraphs and telephones, naval and military defense were taken from the states and vested in the Commonwealth. Four new Federal departments were also created by proclamation, viz., the Department of External Affairs, the Department of Home Affairs, the Department of the Treasury and the Department of the Attorney-General.

Legislative Department of the Commonwealth.— The legislative power of the Commonwealth is vested in a Federal Parliament consisting of the King, or Queen, of the United Kingdom, the Senate and the House of Representatives. The Senate consists of representatives from each of the six states directly chosen by the people of each state voting as one electorate; each state is entitled to six senators. Senators are chosen for six years, one-half retiring every three years. The House of Representatives is composed of members directly chosen by the electors of the Commonwealth; the total number of such members must be as nearly as practicable twice the number of the senators. The Senate is called the State House, the House of Representatives is called the National Chamber, in which the people of each state are represented according to population, save and except that no state is to have less than five members. In the first Parliament, New South Wales sent 26 members to the House of Representatives, Victoria sent 23, Queensland sent 9, South Australia sent 7, Western Australia and Tasmania sent 5 each. The House of Representatives continues to exist for a period of three years from the first meeting, unless sooner dissolved by the governor-general. In case of a deadlock between the two Houses extending over a certain time the governor-general may under certain conditions and circumstances dissolve both Houses and send them to the people; after such a double dissolution a joint sitting of both Houses of the newly-elected members must be held at which they deliberate and vote upon the proposed law in dispute.

The Federal Parliament can make laws respecting trade and commerce taxation, bounties, borrowing, postal and telegraphic matters, naval and military defense, light houses, fisheries, census, currency, interstate insurance, weights and measures, negotiable instruments, bankruptcy, copyrights, patents, naturalization, foreign co-operations, marriage and divorce, old age pensions, service and execution of process, immigration, influx of criminals, external affairs, relations of the Commonwealth with the islands of the Pacific, acquisition of property for Federal purposes, control of railways for naval and military transport, acquisition of state railways with the consent of such state, construction of railways through a state with the consent of such state, conciliation and arbitration for the settlement of interstate industrial disputes, seat of government of the Commonwealth and departments of the public service.

On 1 Jan. 1911 "The Northern Territory" of Australia which had previously belonged to the state of South Australia was transferred to the Commonwealth government. This is an area of 523,620 square miles with a white population of only about 2,000.

Judicial Department of the Commonwealth.— The judicial power of the Commonwealth is vested in a High Court consisting of a chief justice and not less than two other justices. The High Court has appellate and original jurisdiction. It has jurisdiction to hear appeals from all other Federal courts, or courts exercising Federal jurisdiction, and from

the Supreme Courts of states in the exercise of jurisdiction conferred by state laws. The High Court must be regarded as a Federal Court of Appeal, and a National Court of Appeal, and as such it holds a wider jurisdictional area than its great exemplar, the Supreme Court of the United States of America, which cannot entertain appeals from state courts in cases not involving Federal issues. The act confers a new right of appeal from the Supreme Courts of states in state law cases, but it does not abolish the existing right of appeal in those cases to the Privy Council. The latter right still remains. The High Court, though a general Court of Appeal for Australia, is not the sole or exclusive, but a concurrent Court of Appeal in state law cases. Parties to cases decided by the Supreme Courts of state on matters of state law have, therefore, an alternative right of appeal, either to the Privy Council direct or to the High Court.

The judgments of the High Court are declared by the Constitution to be final and conclusive. This negatives the right of litigants in the High Court to appeal to the Privy Council as a matter of right. The appeal as a matter of right has been taken away, but the Constitution has left unimpaired any right the King may be pleased to exercise by virtue of his prerogative to grant special leave of appeal from the High Court to His Majesty in Council. To this reservation of the prerogative to grant leave there is, however, a most important exception. No appeal can be permitted to the King in Council from a decision of the High Courts upon any question as to the limits inter se of the constitutional powers of the Commonwealth and those of any state, or states, or as to the limits inter se of the constitutional powers of any two or more states unless the High Court shall certify that question is one which ought to be determined by His Majesty in Council. The High Court has original jurisdiction to decide all matters arising under any treaty, all matters affecting Consuls, all matters in which the Commonwealth is a party, all matters between states or between residents of different states in any matters arising under the Constitution or involving its interpretation.

For several courts of the states have been vested with Federal jurisdiction to deal with matters arising under the Constitution, or involving its interpretation, and in matters of any laws made by the Federal jurisdiction. In section 101 of the Commonwealth Constitution provision is made for the appointment of an interstate commission. In December 1912 the Fisher government passed the Interstate Commission Act and in August 1913 the Cook government appointed three commissioners to carry out the provisions of the act. The first duty entrusted to them was that they should investigate and report as soon as practicable upon the following matters: (a) Any industries now in urgent need of tariff assistance; (b) anomalies in the existing Tariff Acts which are either technical in character or are due to, or arise from, the incidence of taxation; (c) the lessening where consistent with the general policy of the Tariff Acts of the cost of the ordinary necessities of life, without injury to the workers engaged in any useful industry.

Finance and Trade.— During the first 10 years after the establishment of the Commonwealth, the Federal government had only a limited use of the revenue derived from customs and excise duties. It could only use for Federal purposes one-fourth of the total of the net sum so collected. The remaining three-fourths had to be paid to the several states according to the following method of distribution, viz., each state was credited with the whole of the revenue collected in it and each state was debited: (a) with departmental expenditure actually incurred in such state; and (b) with a proportion on a population basis of the other expenditure of the Commonwealth. The Commonwealth paid to each state monthly the balance in favor of each state. Upon the imposition of uniform customs duties in October 1901, trade, commerce and intercourse, between the states, whether by land or by sea became absolutely free.

Relations of States to the Commonwealth and the Crown.— The relations of the Australian states to the Commonwealth and to the Crown were authoritively expounded by the Secretary of State, Mr. Chamberlain, in the despatch dated 15 April 1903, directed to the lieutenant-governor of South Australia in reference to the case of the Dutch ship *Vondel*. The owners of this ship complained to the British Government that the state government of South Australia had declined to arrest the crew of the ship while she was in South Australian waters. The Secretary of States brought the complaint under the notice of the governor-general of Australia. The Federal government forwarded the papers to the state government desiring them to furnish a report on the case. The state government refused to report to the Federal Government on the ground that the latter had no jurisdiction in the matter. The constitutional issues raised by the action of the South Australian government were dealt with at length in Mr. Chamberlain's despatch. "So far as other communities in the empire or foreign nations are concerned, the people of Australia form one political community for which the government of the Commonwealth alone can speak, and for everything affecting external states or communities which takes place within its boundaries, that government is responsible. The distribution of powers between Federal and state authorities is a matter of purely internal concern of which no external country or community can take cognizance. It is to the Commonwealth and to the Commonwealth alone that, through the Imperial government, they must look for remedy or relief for any action affecting them done within the bounds of the Commonwealth, whether it is the act of a private individual, of a state official, or of a state government. The Commonwealth is, through His Majesty's government, just as responsible for any action of South Australia affecting an external community as the United States of America are for the action of Louisiana or any other State of the Union. The Crown undoubtedly remains part of the Constitution of the state of South Australia, and in matters affecting it in that capacity, the proper channel of communication is between the Secretary of State and the state governor. But in matters affecting the Crown in its capacity as the central authority of the empire, the Secretary of State can, since the people of Australia have become one political

community, look only to the governor-general as the representative of the Crown in that community. The view of your ministers would, if adopted, reduce the Commonwealth to the position of a Federal league, not a federation, and appears to me to be entirely opposed not only to the spirit but to the letter of the act."

Administration and Legislation.—The first Federal government was formed by Mr. (afterward Sir) Edmund Burton. The principal measures passed by the 1st Parliament were as follows: A uniform Tariff Act, an act to restrict immigration by the imposition of an educational test for the purpose of excluding colored races and to exclude laborers coming to Australia under contract of service; an act to abolish Kanaka labor in connection with sugar growing, and to encourage the use of white labor by granting a bonus of £2 per ton on sugar so produced; an act establishing a uniform suffrage for both the Senate and the House of Representatives; a naval agreement with the Admiralty under which the Commonwealth undertook to pay £200,000 per year for 10 years toward the maintenance of a naval force on the Australian station; an act to organize the High Court, of which Sir Samuel Griffith was appointed chief justice, Sir Edmund Barton and R. E. O'Connor, justices.

An administration formed by Alfred Deakin came into office on 24 Sept. 1903. The 1st Parliament was dissolved on 23 November, and the 2d Parliament was convened for business on 2 March 1904. The Deakin Ministry was defeated on 26 April by an amendment to the Conciliation and Arbitration Bill proposed by the Labor party extending it to state railway servants. J. C. Watson then formed a Labor ministry. On 17 August an adverse amendment to the Constitution and Arbitration Bill, limiting the principle of preference to unionists, was carried against the Labor ministry and they resigned. G. H. Reid, leader of the Free Trade party, next formed a government in combination with a number of Protectionists. Parliament reassembled on 26 July 1905 when the Reid Ministry was defeated. Deakin formed his second ministry, receiving support of Labor party. Among the measures passed were a Commerce Act, Sugar Bonus Extension Act and a Trade Marks Act — the latter legalizing the "Union Label." Acts were also passed modifying educational tests and the contract labor clauses of the Immigration Act. In November 1908 Deakin was defeated and Fisher, a member of the Labor party, formed a ministry which was defeated by Deakin in June 1909. Deakin was again defeated in April 1910, Fisher becoming Premier. Fisher was defeated 20 June 1913 and the Hon. Joseph Cook became Premier. He was defeated 17 Sept. 1914 and the Rt. Hon. Andrew Fisher again became Premier, a position he held until 27 Oct. 1915, when he resigned to accept the office of High Commissioner for Australia in London. The Hon. W. M. Hughes then became Premier and is still in office (November 1917).

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6. THE STATES, THEIR CONSTITUTIONS AND GOVERNMENTAL DEPARTMENTS. Colonies Transformed Into States.— Under the Constitution of the Commonwealth Act, the colonies of New South Wales, Victoria, Tasmania, Queensland, Western Australia and South Australia have been converted into states of the Federal Union, and certain legislative, executive and judicial powers formerly vested in colonial authorities have been transferred to the Commonwealth.

Executive Departments of States.— In each state there is a governor representing the King, and he is the head of the executive as well as a branch of the legislature. In the administration of public affairs the governor is assisted and advised by responsible ministers who preside over the public departments and generally have seats in the legislature.

In New South Wales the governor receives a salary of £5,000. There are seven responsible ministers, among whom the public departments are distributed as follows, viz.: (1) premier and treasurer; (2) chief secretary; (3) attorney-general and minister of justice; (4) lands; (5) public instruction; (6) lands and agriculture; (7) the minister for labor and industry and mines. The sum of £10,400 is appropriated for payment of ministers in such proportions as may be arranged among themselves.

The governor of Victoria receives a salary of £5,000; the various public departments are presided over and distributed among ministers as follows, viz.: (1) premier, treasurer and minister of railways; (2) chief secretary and minister of labor; (3) attorney-general and minister of justice; (4) lands; (5) public instructions; (6) works; (7) mines and forests; (8) water supply and irrigation. Two ministers must sit in the Council. The aggregate amount of salary payable among ministers is £8,400 per year. A minister being a member of one house may attend the other house by its permission, and speak upon and explain bills relating to his department.

In Queensland the governor's salary is £3,000. There are seven salaried ministers among whom the offices are distributed as follows, viz.: (1) premier, chief secretary and secretary for railways; (2) treasurer; (3) home secretary; (4) secretary for agriculture and public works; (5) attorney-general, secretary of mines; (6) secretary of lands; (7) public instruction. The aggregate amount of salary payable among ministers is £8,300 per year.

The governor of Tasmania receives a salary of £2,750. Ministerial offices are distributed as follows, viz.: (1) premier and chief secretary; (2) attorney-general; (3) treasurer and lands; (4) mines and works. The aggregate amount of salary payable among ministers is £3,200 per year.

In South Australia the governor's salary is £4,000. There were formerly six responsible ministers, but by the Constitutional Amendment Act of South Australia (1901), the number was reduced to four, and the aggregate salary divisible among them is £4,000 per year. By an act passed in 1913 the number of ministers was raised to six and salaries to £5,000. The offices at present are distributed among them as follows, viz.: (1) premier and treasurer; (2) attorney-general; (3) chief secretary; (4) lands and agriculture; (5) public works; (6) industry and mines.

The governor of Western Australia receives a salary of £4,000. There are six ministers holding offices as follows, viz.: (1) premier and treasurer; (2) attorney-general and education; (3) colonial secretary; (4) works and industry; (5) mines and water supply; (6) lands and agriculture. The aggregate amount of salary payable among ministers is £6,200 per year.

Legislative Departments of States.— The state Parliaments have no longer any control over customs, excise, post-offices, telegraphs, telephones, navy and military defenses.

The Parliament of New South Wales, like that of every Australian state, consists of a Legislative Council and a Legislative Assembly. The Council is still a nominated body as it was at the beginning of responsible government, being composed of 56 life members. There were before Federation 125 members of the Assembly; in 1901 that number was reduced to 90 as one of the results of the transfer of certain powers and functions to the Commonwealth government. Plural voting was abolished in 1893. Manhood suffrage, established in 1858, was in 1903 superseded by adult suffrage; that is to say, "one adult person one vote." Since 1899, each member of the Assembly receives the sum of £300 per year in reimbursement of his expenses together with a free railway pass. Members of the Council receive free railway passes but no payment. The Assembly is a triennial chamber, but it may be at any time dissolved by the governor. Elections are conducted by ballot; this being the method of election of members in all the Australian states.

By the Constitutional Amendment Act (1903), the Legislative Council of Victoria consists of 34 members, one of whom is directly elected by, and represents, the public and railway servants: the others are elected by qualified voters of whom there are three classes, viz.: (1) owners of freehold land of the annual value of £10; (2) rate-paying occupiers of land of the annual value of £15; (3) university and professional men. The property qualifications of a member of the Council were formerly ownership of freehold land of the annual value of £100; that has been reduced to £50. The tenure of a seat in the Council is six years, one-half the members retiring every three years. In the event of a deadlock between the two Houses on matters of ordinary legislation (constitutional alterations being excepted), the governor may, subject to certain conditions, dissolve both Houses. The council has power by message to the Assembly to suggest amendments in the Appropriation Bill. Manhood suffrage coupled with "no plural voting" is the franchise for the Assembly in addition to which, however, every owner of freehold land of the capital value of £100, and of the annual value of £5 is entitled to be registered for, and to record his vote in every electoral district in which such land is situated; the act abolishing plural voting prohibiting him, however, from voting more than once on the same day. There are 65 members of the Assembly. Public and railway officers are unable to vote in and for ordinary electorates; instead of which they are allowed to choose three special members to represent them in the Assembly. Members of this House receive £300 per year, and a free railway pass. Legislative councillors receive free railway passes but no payment. The Assembly is a triennial chamber, but it may be dissolved by the governor at any time. Every elector is qualified to be chosen as a member.

In Tasmania the Legislative Council consists of 18 members elected by resident inhabitants possessed either of freehold land of the annual value of £20, leasehold of the annual value of £40, or having university or professional qualification (Constitutional Amendment Act, 1901). The Assembly consists of 30 members elected by adult suffrage coupled with residential qualification. Members of both chambers receive an honorarium of £100 each, subject to their attending a certain number of days per session. An act to confer the franchise on women was passed in 1904.

In Queensland the Legislative Council, like that of New South Wales, is a nominated body consisting of 40 members; they are appointed by the governor in council, and subject to certain attendance each session they hold their seats for life; they receive no payment, but are entitled to free railway passes. The Assembly consists of 72 members elected practically by manhood suffrage; but owners of freehold land of the value of £100, and household occupiers of the annual value of £10, are entitled to vote in every electoral district in which they have that property qualification. The Assembly exists for three years unless previously dissolved, and its members receive a remuneration of £300 per year, and free railway passes, and allowances for traveling expenses. Every elector is qualified to be chosen a member.

In Western Australia the Legislative Council consists of 30 members elected by adult persons having as a qualification, either, freehold lands of the capital value of £100, or leasehold of the annual value of £25, or being Crown lessees or licensees of land of the annual value of £10. The tenure of seats is six years; one-third retiring every two years (Constitution Act, 1890). The Assembly consists of 50 members elected by adult persons being residents of an electorate, but persons having freehold land of the capital value of £50, or leasehold land of the annual value of £10, are entitled to vote in any district in which they hold the property qualification. The Assembly, like other popular chambers of Australia, is a triennial House. A bill conferring the franchise on women was passed in the year 1899.

Under the provisions of the Constitutional Amendment Act (1901), the number of members of the Legislative Council of South Australia was reduced from 24 to 18. Under earlier acts the members are elected by adults of both sexes, having as a property qualification either a freehold estate of the capital value of £50, or

a leasehold of the annual value of £20 with three years to run, or being the occupiers of dwelling-houses of the annual value of £25. Members of the Council hold their seats for six years, one-half retiring every three years; unless the chamber is sooner dissolved by the governor; which can be done in cases of disputes, or deadlocks between the two chambers extending over a certain time. By the Constitutional Amendment Act of (1901) the number of members of the Assembly was reduced from 54 to 42. By an act passed in 1913 the number in the upper House was increased to 20 and in the lower House to 46. The Assembly is a triennial chamber, unless previously dissolved. In the event of a deadlock between the two Houses in reference to a proposed law it is within the power of the governor to dissolve them both, subject to the following limitations, viz.: (1) It must have been passed by the Assembly and rejected by the council in one session; (2) it must have been, after a general election, passed a second time by an absolute majority of the whole number of members of the Assembly and a second time rejected by the Council. Members of both Houses are entitled to receive £200 per annum each and free passes over government railways.

Judicial Departments of States.— The Supreme Court of New South Wales is constituted under Act 4 Geo. IV, c. 96, and 9 Geo. IV, c. 83. It consists of a chief justice and six other justices. It has unlimited civil and criminal jurisdiction. Circuit districts and Circuit Courts are established to try civil actions and determine crimes and misdemeanors. The Supreme Court has appellate jurisdiction to hear appeals from all inferior courts. There are seven District Courts having jurisdiction in personal actions not exceeding £200 and a limited criminal jurisdiction. Courts of Petty Sessions having summary jurisdiction to deal with minor offenses and a limited civil jurisdiction presided over by a stipendary magistrate, or by two or more justices, exist in all cities, towns and centres of population.

There is a Supreme Court in and for Victoria, constituted under the authority of the Constitution. It consists of a chief justice and four justices. It is unlimited in civil jurisdiction as well as jurisdiction to try crimes and misdemeanors; as a full court it has appellate jurisdiction from all inferior tribunals. Courts of General Sessions of the Peace having jurisdiction to inquire into a limited class of indictable offenses and to hear appeals from Courts of Petty Sessions exist in certain proclaimed districts. Wardens Courts and Courts of Mines exist for hearing mining disputes; County Courts having authority to decide all personal actions up to the amount of £500; Courts of Petty Sessions having summary jurisdiction in minor criminal matters and civil jurisdiction up to the amount of £50.

The Supreme Court of Tasmania consists of a chief justice and two puisne judges; it has both original and appellate jurisdiction in common law, equity, ecclesiastical and criminal matters. Local courts can deal with civil matters, some up to £100, and others up to £50. Justices in Petty Sessions can make convictions and orders in minor or criminal matters.

The Supreme Court of Queensland may be composed of not less than four, and not more than five, judges. It has the same jurisdiction as the Superior Courts of Common Law, and the High Court of Chancery, in England; it also possesses ecclesiastical and criminal jurisdiction. An appeal lies to the full court from all inferior courts. District Courts are vested with a limited civil and criminal jurisdiction. Courts of Petty Sessions and Small Debt Courts exercise a limited authority in specified civil and criminal matters. Wardens Courts are constituted to deal with mining disputes.

The Supreme Court of Western Australia was established by Royal Charter in 1861, and the main provisions relating to its constitution and jurisdiction are contained in the Supreme Court Act (1880). It has jurisdiction in common law, equity, ecclesiastical and criminal matters. Local courts similar to those in some of the other Australian states can decide small debt cases. Justices in Courts of Petty Session can summarily convict, imprison or fine persons guilty of minor offenses. Wardens Courts have authority to deal with mining cases.

The Supreme Court of South Australia is composed of a chief justice and two other puisne judges. Its jurisdiction extends to all matters of law and equity. It has also jurisdiction in crimes and misdemeanors. It is the court of appeal from the decisions of all inferior courts. South Australian local courts are to some extent analogous to the District Courts and County Courts of other states. Some of these courts have jurisdiction in civil matters up to the amount of £490; other local courts are limited to actions where the debt or damage claimed is no more than £20.

Bibliography.— See article AUSTRALIA — POLITICAL HISTORY.

SIR JOHN QUICK,
Postmaster-General in Deakin's Commonwealth Government, 2 June 1909 *to 29 April* 1910, *Joint Author of 'Constitution of Australian Commonwealth'.*

7. MUNICIPAL AND LOCAL GOVERNMENT. Introductory and General.— The organization of municipal government in Australia is modeled largely on the English system and is composed of mayors, aldermen and councillors in the chief cities and large towns, with district or shire councils, local or divisional boards (the nomenclature varies in the different states) presided over by elected chairmen or presidents in the small towns or villages, and outlying districts where settlement is sparse. All of these are creations of statute deriving their authority, power and duties from the Parliaments of the various states. No salaries are paid to the mayors who in the capital and most of the larger towns are voted an annual allowance by the councils for entertaining and keeping up the traditional dignities of the office. In Melbourne the vote is £1,500, in Sydney and Adelaide £1,000. The mayor has no direct power of veto over the council's actions. He represents the city as a whole and presides over the council and undertakes only those duties which devolve naturally on the leading officer of a city. The paid officials are non-partisan appointed by the councils and form a permanent staff holding their positions during good behavior; the head of which (as in England) in the cities is the town clerk. The terms municipal and local government are inter-

changeable as applying to (a) the cities and the larger towns of the Commonwealth, of which the capitals are types, and (b) to the smaller towns and outlying districts which are simply microcosms like unto the larger bodies but with functions of a more prosaic and limited character conditioned mostly by population. In fact it may be taken as axiomatic that when the government of the cities is understood everything of importance to the student is known about municipal and local government in the Commonwealth of the newest of the nations.

Nominations for municipal offices usually require the signatures of proposer, seconder and candidate. In Melbourne 10 ratepayers' signatures are required together with a deposit of £10. Secret voting, or voting by ballot as it is styled, is the universal system, which had its origin many years ago in Australia and has since found world-wide acceptance.

Generally speaking adult owners and occupiers of real estate assessed for taxation who have paid their rates, whether residents or non-residents, are entitled to vote in the cities of Australia. Aliens are barred in some cities and women are not yet universally welcomed to the council chambers although they may vote.

The councils of the capital cities are single chambers, aldermen and councillors sitting together, presided over by the mayor. Except in the Federal government, and in the state Parliaments where it is universal, the bicameral system of government as it exists in some American cities is unknown in Australia.

The Origin of Local Government.—The beginning of municipal government in Australia dates back to 1839 when the first municipal law (based on the English statute of 1835) was passed in the state of South Australia and put into operation in 1840 in the city of Adelaide whose virgin soil was surveyed in 1836. The parent city of Sydney, the capital of New South Wales, established in 1788, was incorporated in 1842. Melbourne, the chief city of the state of Victoria, originated as a small settlement in 1835 and was incorporated in 1842 by the legislature of New South Wales of which state it then formed an integral portion. The other capital cities are: Brisbane (Queensland), founded 1826, incorporated 1859; Perth (West Australia), founded 1829, incorporated 1871; Hobart (Tasmania), founded 1804, incorporated 1857.

Local Government in New South Wales.—The city council of Sydney is composed of 24 aldermen, one of whom is elected by the council annually to be lord mayor. Two aldermen for each of the 12 wards are elected by ballot by the ratepayers every two years. Plural voting obtains, based on assessment values up to four votes. Owners, leaseholders, occupiers and lodgers are entitled to vote. Accounts are audited by state government inspectors. Assessments are based on rental values of improved property.

The condition of local government in this state is admittedly unsatisfactory. In the metropolitan area the agitation for a "Greater Sydney" is still proceeding by which its advocates hope that the city council will absorb the small surrounding suburban local governing bodies, of whom there are no less than 41, each with its own separate mayor, council, officered staff and administration.

The number of municipalities in New South Wales is only 188, covering an area of 1,810,912 acres with an annual value for assessment purposes of £10,309,655 and a very large area still remains under the control of the state government which is now considering proposals to extend the system of local government by the creation of shire councils and new municipalities, allowing such bodies to levy their rates on the unimproved capital value of the land instead of on the annual value of improved property.

Besides the municipalities there are boards and trusts composed of members appointed by the state government and members appointed by various municipal bodies, which are established for the benefit of districts covering areas of two or more ordinary municipalities and are empowered to construct and supervise waterworks, drainage works and similar undertakings with power to raise money by the sale of debenture stock and levy rates on the assessed value of benefited properties. In New South Wales there are the metropolitan board of water supply and sewerage, various harbor trusts, country water trusts and the metropolitan fire brigades board, on which latter representatives of the fire insurance companies sit who contribute to the upkeep of the brigades.

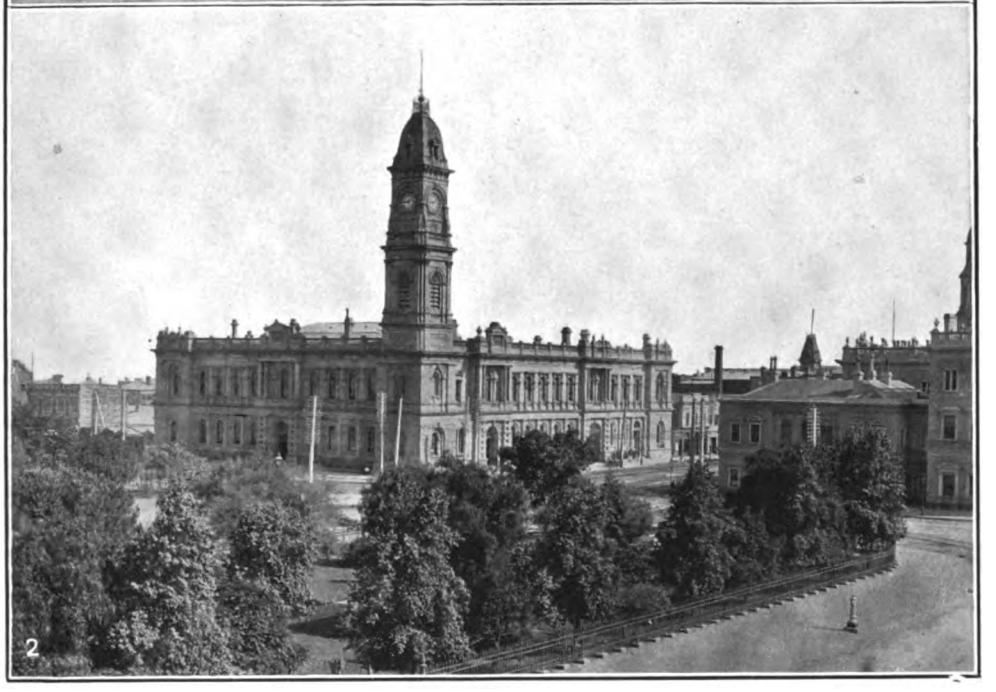
Local Government in Victoria.—The city council of Melbourne consists of 28 members (seven aldermen and 21 councillors) presided over by the lord mayor who is elected annually by the council. Three councillors are elected for each of the seven wards of the city, one being chosen annually by plural voting for a period of three years. The aldermen are appointed by the council and hold office for four years. Residence within seven miles of the city and minimum rating of £10 qualifies for a vote which slides upward to three votes on a £150 assessment.

This state has had a comprehensive system of local government in force for many years which divides it into cities, towns, boroughs and shires; the councillors are elected by the ratepayers, and the mayors of cities, towns and boroughs, and presidents of shires by the councillors. The total area under local control is 87,302 square miles, only 582 square miles remaining outside of local government.

Melbourne and 22 suburban municipalities constitute the metropolitan area, and thoughtful students of local government look forward to the time when all or most of these will be amalgamated with the city. A royal commission has taken most exhaustive evidence pro and con during the past three years but so far has not submitted its report.

Other governing bodies outside, yet dovetailing in with the municipal councils and the state government in Victoria, are the metropolitan fire brigades board, the Melbourne harbor trust, the tramway trust consisting of representatives of the Melbourne city council and 11 other suburban municipalities, the metropolitan board of works controlling water supplies, sewerage and drainage and various other waterworks, irrigation and water supply trusts under quasi-local and quasi-state government control.

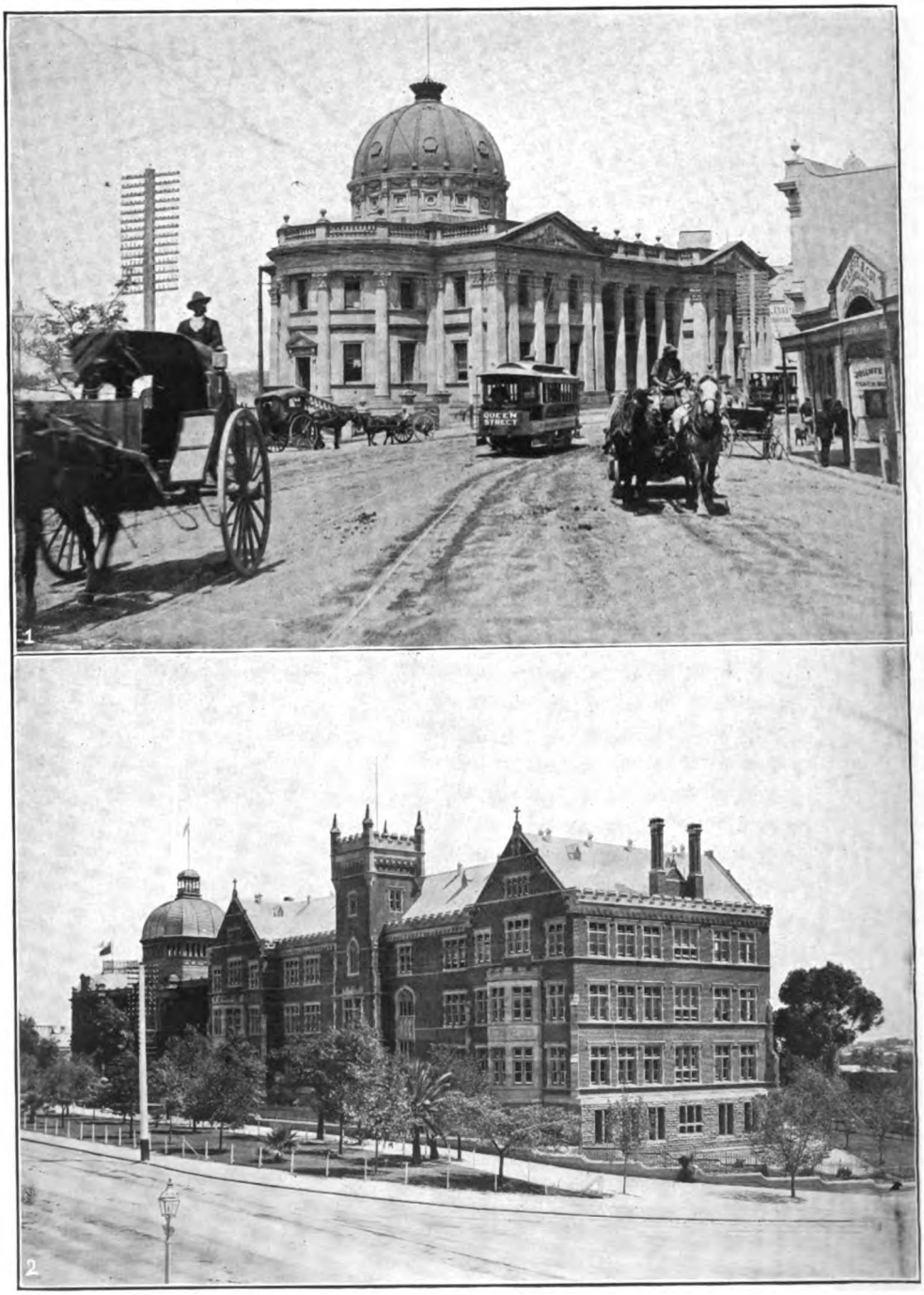
Local Government in South Australia.—The council of the city of Adelaide consists of



1 King William Street, Adelaide

2 General Postoffice, Adelaide

AUSTRALIA



1 Customs House, Brisbane

2 School of Mines, Adelaide

the mayor, six aldermen and 12 councillors. All of them including the mayor are elected by the ratepayers. The mayor and aldermen hold office for one and three years respectively; the councillors (two for each of the six wards) hold office for two years. At each annual election the mayor, two aldermen and six councillors are balloted for. Plural voting obtains for mayor and aldermen, the system allowing a citizen one vote in each ward where he has property assessed. The state is divided for local government purposes into municipal and district councils. Aldermen may be elected to suburban councils in addition to councillors after a poll of the ratepayers has been taken approving such a proposition, followed by a proclamation by the state governor, and it is worthy of note that the chairmen of the district councils are elected not by the ratepayers but by the members of the councils. The annual assessed value of property in municipalities is £2,661,238. There are no boards or trusts (other than the fire brigades board) of any importance, but very extensive powers are vested in corporate bodies who may raise loans for the construction and working of tramways, ferries, jetties, waterworks, gas works, electric-light works, baths and washhouses, abattoirs, markets; and make and provide pleasure grounds, libraries, museums, hospitals and asylums.

Local Government in Queensland.— The city council of Brisbane comprises 14 members who are styled aldermen, one of whom is elected annually to be mayor. The capital value of land is assessed here and not the rental value. The owner or occupier has from one to three votes according to valuation. If, however, the property is valued at less than £120, only the occupier has a vote.

A general system of local government was started in 1878 and revised in 1902. Local areas are divided into cities, towns and shires. Members of councils are styled aldermen in cities and towns and councillors in the shires. Aldermen and councillors are elected by ratepayers in each area, but all mayors of cities and towns and chairmen of shires are chosen by the members of the councils. The total area controlled by local bodies is 668,252 square miles, leaving only 245 square miles unincorporated.

In Queensland the water supply construction work is undertaken by the state government and when complete is handed over to the local authorities with attendant liabilities, which become a debt due from the local authority to the state government which must be repaid in instalments. There are a few bridge boards and harbor boards in various districts

Local Government in West Australia and Tasmania.— The city of Perth — the capital of West Australia — is governed by a mayor and 15 councillors, all of whom are elected by the ratepayers. For ward elections there are two classes of voters and for general municipal elections four. The local governing bodies in West Australia are termed municipalities, water boards, road boards and health boards; the latter may be established within or without municipal boundaries. Members of boards are elected by ratepayers and the chairmen by the members.

In Hobart — the capital city of the island state of Tasmania — the council consists of nine aldermen, one of whom is elected by the members to be mayor. The aldermen are elected by plural voting with a minimum qualification of £8 annual value, the scale being from one to seven votes, according to assessed value of property.

Tasmania has its outlying districts governed by town boards and road trusts. The ratepayers in these districts elect their representatives who are termed «councillors» and these councillors elect their chairman who is styled «warden.»

Powers and Duties of the City Councils. — The functions of the city councils are legislative as well as administrative. They are empowered under statutes granted by the state Parliaments to make by-laws for the suppression of nuisances for all matters of minutiæ relating to good rule and government, and affecting the comfort, convenience and welfare of their inhabitants. They may levy rates to cover the cost of general administration and raise loans (under certain restrictions) when necessary for public works. Properties exempted from payment of rates are Federal and state government buildings (including state schools), charitable and benevolent institutions, churches, chapels and buildings used exclusively for public worship, and buildings privately owned which are used exclusively as schools. They are charged with the control of traffic, the testing of weights and measures, the construction and maintenance of roads, bridges and footways, the care and management of parks and recreation grounds, public baths, street lighting, sheep and cattle markets, meat, produce and fish markets, abattoirs, the collection and disposal of garbage, trade refuse, and they may and do hold large properties in real estate. They supervise the erection and construction of buildings and in some cities have jurisdiction over theatres, music halls and places of public entertainment as to fireproof materials and means of exit. They regulate sky signs and scaffolding and in most cities license cars, cabs and conveyances plying for hire.

Public Health and Sanitary Functions.— The city councils are constituted as boards of health and are responsible in their areas for the proper administration of the various public health acts to the state boards of health or government commissioners as the case may be. They inspect and license private hospitals and maternity homes and employ medical officers of health and staffs of inspectors (male and female) whose duties are to look after the adulteration of food and to have the oversight of food supplies (particularly meat, milk and bread), inspection of common lodging-houses, dairies, milkshops and dairy cattle; noxious trades and businesses, abatement of common nuisances and smoke nuisances; to prevent spitting in the streets and in public vehicles; to inspect restaurants, fish shops, butcher shops and all premises where food is prepared or consumed; to prevent overcrowding of premises; and to attend to matters of isolation, disinfection and hospital accommodation for infectious diseases and fevers.

Notification of disease is generally compulsory under penalty. Medical practitioners, heads of families and relatives are all liable for

neglect. In compulsory notification of pulmonary tuberculosis (consumption) the state of South Australia has led the way, and the difficulties and dangers feared by some medical men have been found to be mythical and non-existent.

Budget Items and Flotation of Loans.— The chief sources of municipal revenue are income from rates, rents from real estate, market dues, fines, penalties and license fees.

The rates levied in the city of Adelaide may be taken as typical of Australia and are as follows: General purposes, rate, one shilling in the pound; street lighting, rate, three pence; parks and gardens, rate, one halfpenny; rate for sinking funds (loans), one halfpenny; rate for police purposes, two pence; and a sanitary rate of three pence. To which must be added a water and sewerage rate of one shilling and sixpence in the pound (levied by the state government), making a total of three shillings and three pence to be paid by the citizens, which in comparison with the rates charged in London and most of the large populous cities of Great Britain is an exceedingly light impost.

The expenditure budgets of the cities contain as principal items: Road and footway maintenance, upkeep of parks and gardens, baths, markets and kindred establishments, salaries and wages. Day labor invariably obtains except on new construction work. The wage of the ordinary unskilled municipal laborer is on an average of 8/6 per day — in some cities slightly higher.

Loans are mostly raised by the sale of debenture stock, redeemable at due dates, although in some instances the state government advances money and becomes the creditor of the local authority. In Sydney and Melbourne, bills are passed by the state Parliaments authorizing those cities to float loans for street construction work, establishment of electric light, erection of markets, etc. In Victoria, outside the capital, the limit of indebtedness for municipalities is fixed at 10 times the amount of annual income; the establishment of a sinking fund is obligatory with an annual appropriation of not less than 2 per cent of the amount of the debt. A law similar in many respects exists in Western Australia. A referendum of any proposed loan may be demanded in Victoria and the consent of the state governor is required in Western Australia.

In New South Wales municipalities may borrow on debentures, with the sanction of the state governor, any sum not exceeding the total estimated amount of revenue for an ensuing five years.

In South Australia the consent of the ratepayers is required preparatory to floating any loan, the maximum indebtedness of a municipality is fixed, sinking funds are compulsory, and where the loan is to be applied to works of a non-revenue producing character, a rate must be struck to provide sinking fund and interest.

Statistics of the Metropolitan Cities.— In any survey of the progress of modern civilization the concentration of population in cities is the most startling fact. It is a world-wide movement and is nowhere more strikingly exemplified than in the cities of Australia. The progress of the chief cities has been remarkable and has no parallel among the cities of the old world. Even in the United States the rise of the great cities has been accompanied by a corresponding increase in the rural population, but in Australia (perhaps for the first time in history) is presented the spectacle of magnificent cities growing with marvelous rapidity and embracing within their limits one-third or more of the population of the states of which they are the seat of government.

The population and annual assessment value for rating purposes of the metropolitan areas are illustrated in the following table.

State.	Annual value 1913.	Population 1913.
Sydney	£5,669,670	725,400
Melbourne	4,489,181	651,000
Brisbane	1,167,135	151,000
Adelaide	1,201,996	201,000
Perth	378,266	121,000
Hobart	175,194	40,000

City Functions Controlled by the States. — The police, although supervising traffic and administering city bylaws and regulations, are controlled and paid by the state governments with the one exception of South Australia where the city and all other municipal corporations are compelled to contribute a moiety of the cost in each district. Education is invariably state controlled although private schools exist. The care of the poor is attended to by the states side by side with religious and philanthropic institutions. Prisons, asylums and hospitals are under the charge of the central governments, although the local authorities are compelled to pay for the accommodation in some states of indigent cases of infectious disease. The cities generally take no share in the management of public libraries, museums, technical schools and art galleries which exist in every capital. Telegraphs and telephones are entirely controlled by the Federal government. Tramways (street railways) are in the hands of the state government in New South Wales and in the other capitals are owned and operated by private companies, under charters granted by the state Parliament. Provision is, however, made in some states, notably in Melbourne and Perth, for the metropolitan municipalities eventually taking them over. Gas works and supplies are mostly owned and operated by private companies. Electric lighting is owned and operated municipally in Melbourne and Sydney. In Adelaide the private company's existing rights expired in 1908. Fire brigades are managed by boards, with municipal representation upon them. Water and sewerage are managed either by state government departments or quasi-government boards.

The Municipal Outlook for the Future.— The municipal limits of the capital cities of Australia by no means correspond to their social, industrial and economic boundaries; as municipal centres they are the "pulses" which contain only a fraction of the population of the metropolitan areas and are only just now waking up to the necessity of bringing into being comprehensive Greater Sydneys, Greater Brisbanes, Greater Melbournes and Greater Adelaides. The same sociological forces are at work in Australia as in America, Great Britain and the continent of Europe, where enlargement of areas and greater cities have been dominant planks in municipal platforms for years. We may therefore expect similar results to fol-

low in Australia as have been achieved elsewhere in the course of the next decade.

Some small effort in this direction has already been accomplished, notably in Brisbane and Melbourne by the recent absorption of one or two adjacent suburbs, but the movement generally can hardly be said to have yet passed much beyond the embryonic stage.

In the metropolitan areas of Sydney, Melbourne and Adelaide there are respectively 41, 22 and 19 municipal governing bodies with bewildering codes of bylaws and methods of administration, and it has been well said that on the score of economy alone the arrangement is an absurdity which tolerates within a 10-mile radius of the centres such an enormous number of local governing bodies — each separate, distinct and independent of the other — to manage the affairs of from 160,000 to half a million of people with, of course, as many staffs of municipal officers, all working in isolation, and often unable to agree about matters of vital concern to all. Experience has shown that occasional conferences are at best but an inadequate substitute for a permanent body with a fair representation of all interests and smoothly working machinery. Whether reform takes the shape of federation or unification, whether it comes with a rush or gradually, as the dwellers outside the city bounds awaken to the advantages of co-operative effort — come it must, in order to permit the carrying out of work at present impracticable, such as the control and working of tramways, gas and electric light concerns and kindred undertakings. With the example of the London County Council before us it is obvious that it pays to concentrate as much as possible the municipal work of cities in one central body. Lord Roseberry has said that "the larger the sense of municipal responsibility which prevails the more it reacts on the community itself. And men outside the municipality, or who have hitherto held aloof from municipal government when they see the higher aims of which the municipality is capable, when they see the wider work that lies before it, when they see the incomparable practical purposes to which the municipality may lend its great power, are not inclined any longer to hold aloof." The broad policy of the London county council is proof of this where the finest intellects in England take their share of the work in common with those who are attracted to the Council of the Nation at Westminster.

Notwithstanding its shortcomings the development of municipal government in Australia exhibits an upward and progressive tendency. The cities have always been free from that gross corruption which has been such a marked feature and has wrought such pernicious results in some other countries. Municipal government in Australia stands for probity and purity and as a recent Australian writer in 'The Annals' of the American Academy has put it: "We are undoubtedly further advanced to-day than we were 20 years ago, and we may reasonably hope that the silent evolution which is working out its eternal purposes in the social, as truly as in the physical world, will equip us for the achievement of higher things in the future." Consult Ellery, 'Health Ministration of the Health Act' (1907), and Murdock, 'The Australian Citizen' (1912).

See also *General Bibliography* under AUSTRALIA — POLITICAL HISTORY.

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8. EDUCATION. Formed, like the United States, by the union of previously autonomous communities, the Commonwealth of Australia has followed the example of the United States in the distribution of powers between the Federal and state authority. That is to say none but enumerated powers have been conferred upon the Commonwealth, and all unenumerated powers remain in the hands of the originating states. Thus education, not being among the enumerated powers, is retained, as in the case of America, by the individual states. Every man, and in recent years, every woman, possesses, after registration, a parliamentary franchise, and it is customary to subject knotty public questions to a direct referendum to the people of a state. Such a degree of democracy could exist only in a highly enlightened community. Elementary education, therefore, being essential for the exercise of the duties of citizenship which are imposed upon all, is compulsory, and the corollary follows that it is in almost every case free; otherwise the school fees would amount to a poll tax on children, which in a country crying out for population is the most undesirable of imposts. Being for the benefit of all and not of any sect, state education is secular; and this not from any disregard for religion, but because experience has proved that when the state concerns itself with dogma, strife rather than religious amity is produced. Education was in the early days of each colony left to private enterprise. Before long, however, it was recognized consciously by some and instinctively in the majority, that a function so essential to the general welfare must be regarded as a duty of the state. So it came to pass that education was one of the first matters of public concern to be included in the ever-widening of the sphere of state activity which is the most characteristic movement of the present age. Primary education is accordingly throughout Australia undertaken by the several governments.

There is a general resemblance in the conditions which those who settle in new countries are called upon to face. The problems of education in Australia are very similar to those in America. The circulars of information issued by the bureau in Washington have been of the greatest assistance to the educational departments in Australia, and several useful reforms have derived their inspiration from this source. The laws relating to education in the Australian states, as might naturally be expected in adjacent communities springing from the same stock, bear a strong family likeness; but as considerable intervals intervened between the dates of colonization, and as the science of education was steadily progressive, the system adopted by each state was colored with the views which obtained at the date of its foundation. The older colonies had, therefore, a more difficult task in bringing the laws into conformity with improved methods than those which at a later period were established on ground unencumbered. All have, however, now come into

a fairly uniform line. The sequence of evolution has been the same, although the successive steps taken were independent and not simultaneous. In the beginning of each colony the first schools were established by the churches, aided by government grants. Soon, however, state non-sectarian schools were established and the subsidies to private schools ceased. The state schools were in the first instance placed under the control of a Board of Education appointed by the government; but the basic British idea of responsibility to Parliament asserted itself, and a cabinet minister was vested with the powers previously exercised by the board. The Minister of Education or of Public Instruction, as he is sometimes termed, appoints and dismisses teachers and officers, arranges the curriculum and controls the whole department. Regulations framed by him and approved by the governor in Council acquire the force of law after they have been laid before Parliament. This centralized administration is mitigated, and to some extent, assimilated to local conditions, through the agency of district inspectors and local boards of advice. The funds necessary for education are derived from the general revenue. From time to time attempts have been made to place a portion, at least, of the burden upon the local rates, but it is felt that the cost of a system designed for the benefit of the public at large should be met from a source to which, either directly or through the customs, all contribute. In New South Wales and Tasmania fees are still levied, but in the former these amount to only a fraction of the whole expenditure, and are about to be abolished; and in the latter there are free schools in the large towns. The net yearly cost to the states of primary instruction per scholar in average attendance, excluding the cost of school premises, varies from £4.6.5 to £7.8.1, the average of all six states being £6.8.9.

The statutory school age is in New South Wales and Western Australia from 6 to 14 years; in Victoria from 6 to 13; in Queensland from 6 to 12; in South Australia and Tasmania from 7 to 13. Pupils under the maximum age are exempted from further attendance if on examination they pass a prescribed standard. Attendance is required in New South Wales on 70 days, and in Queensland on 60 days in each half year; in South Australia on 35 days in each quarter, and in central districts on 8 out of 10 school sessions in each week; in Victoria on 75 per cent of the days in each quarter; in Western Australia and in Tasmania on every day on which the school is open. As a rule, children under the age of nine, living within a radius of two miles by road from a state school, and those between nine and the maximum age living within a radius of three miles, come under the laws relating to compulsory attendance. Truant officers and in some cases the police are employed to enforce the law. Prosecution and punishment of the parents of defaulting children is when necessary resorted to without hesitation.

State schools in Australia come under the category of public, provisional, half-time and special. In most of the states a public school may be established if an average attendance of 20 can be maintained. The buildings are provided by the department. In Queensland an average attendance of 30 is required, and the locality has to contribute one-fifth of the cost of erection and maintenance of the building. Where the average attendance is under 20, but over 12, the school is termed provisional. In sparsely populated districts half-time and special schools or itinerant teachers are provided. The policy of concentration of attendance has been largely carried out, children are carried free to and from school over the state railways in New South Wales and in Tasmania. In Victoria they are carried at reduced rates. It is not unusual to see a passenger train stop at cross roads to pick up a group of children on their way to or from school. In many cases it is found to be more economical to make an allowance to parents for the conveyance of children to a school than to bring a school to the children. Moreover, better schools can be provided and higher standards maintained under the "conveyance" system which there is a disposition to extend. The schools will then still better serve the purpose of central or consolidated schools. The average attendance of pupils at the state schools is at the rate of about 62 per school, 30 per teacher, and 11.51 per cent of the population; the average enrolment being 15.59 per cent.

Normal schools are provided for the training of teachers, and are usually recruited from those who have served for four years as pupil teachers. In South Australia a six-year course has been arranged for the training of teachers; two years are spent in study combined with a certain amount of practical work; two years in teaching in the schools, and the final two years at the university. During the term of training the students receive a maintenance allowance from £30 to £80. The schools are classified according to the number of the children in average attendance, and progressive grades of certificates are awarded to teachers which qualify them for appointments in the public schools. Uncertificated teachers are frequently employed in the provisional schools. In all the states with the exception of New South Wales, there is a preponderance of female teachers. The salaries of male head teachers range upwards to £450, and of female head teachers to £360. Male assistants receive from £60 to £262, and female assistants from £50 to £216. The salaries of provisional teachers run from £66 to £140. Payment by results has proved unsatisfactory in operation and has been practically abandoned. The system of inspection is less mechanical than formerly and several of the states exempt schools of recognized excellence from detailed examination, leaving the promotion of the scholars in the hands of the head teacher. Boards of Advice visit, inspect and report upon the schools in their district, are authorized to expend small sums on the school buildings, arrange for the use of the buildings out of school hours, and take part in the administration of the compulsory clauses of the Education Acts. The Boards of Advice are honorary. In some cases they are nominated by the executive, in others they are wholly or partly elective. In Queensland there is usually

a committee for each school. In no case, however, has the theoretically desirable association of the official with a public body on each plane been achieved, viz., a school committee acting with the teacher, correlated with a Board of Advice co-operating with the district inspector, and a Central Council stimulating, assisting, and, if need be, acting as a check upon the Minister. Education falls short of its object if the department does not carry parents and the locality along with it. The schools, when the public sympathizes with their work, exercise a vitalizing and elevating influence on the whole neighborhood. There is no caste system in Australia. The state schools are intended to meet the requirements of rich and poor alike; it is not uncommon to see the child of a cabinet minister or of a wealthy citizen imbibing the elements of knowledge by the side of the child of an artisan or laborer.

The education in the state schools is practical and is now designed as a preparation for the actual requirements of modern life rather than for the conditions that obtained in the Middle Ages. The pupil is led by carefully graded steps from the known to the unknown; from the particular to the general; from the concrete to the abstract; "from the microcosm of the school to the microcosm of the Universe."

The tendency is to subordinate theory to practice. Language is taught before grammar; religious conduct precedes dogma. Kindergarten methods, local geography, nature study, drawing, clay modelling and manual training are taking the place of purely literary studies. History as now taught in Australia is less concerned than formerly with the character of mediæval kings, it is studied more with the view of inculcating patriotism, civic duties and responsibilities. Since the contingents from Australia bore arms with comrades from the mother country and the cementing power of kindred blood shed in common cause has been realized, the Union Jack is saluted in the schools of the Commonwealth as is the Star Spangled Banner in those of the United States. Arbor Day was instituted in the schools of South Australia in 1887 and the celebration has become general throughout the states. On this day the ordinary school work is suspended. The children assemble in the morning and in the presence of the mayor or chairman of the Board of Advice and other visitors, plant trees with some ceremony. After a few speeches and some words as to the care of trees and their usefulness, the school is dismissed and the rest of the day is enjoyed as a holiday. All new country schools in South Australia are surrounded by a reserve of several acres. Some of the schools adopt practical agriculture as a form of manual training, and in all the states teachers are encouraged to make, with the aid of the children, gardens around their schools.

In some of the states there are manual training centres at which pupils drawn from the surrounding schools receive instruction from special teachers. In South Australia the ordinary teachers are encouraged to qualify themselves in this branch of education. The greatest latitude is given as to the form of the instruction; for that subject is taught best in which the teacher feels the deepest interest. Chip-carving, joinery, brush-making, book-binding and wire work are among the subjects taken up in the various schools. Domestic economy and cookery are taught to girls in most of the states. Calisthenic class exercises to a musical accompaniment are commonly adopted as an attractive form of physical training. The pupils are taught by drill to move in masses and the order is occasionally given for fire parade. The Cadet Corps are under military supervision. Rifles are supplied to the boys, but they have to provide themselves with an inexpensive uniform. Swimming is taught in some of the schools. The teaching of singing by the tonic solfa method is a prominent feature. The principles of morality are sedulously instilled and good manners cultivated. Special attention is given to temperance lessons in almost all the states.

The average minimum time devoted to secular instruction is four and one-half hours each day. This stipulated condition being fulfilled certain facilities are provided for imparting religious instruction. In New South Wales and Western Australia the word "secular" is held to include religious teaching of a general as distinguished from that of a dogmatic character; and the teachers, in the performance of the ordinary day's duty, give Scripture lessons based on those issued by the Commissioners for National Education in Ireland. In South Australia, if the parents at any school so desire, teachers may be required to read without note or comment a portion of Scripture for a quarter of an hour before ordinary work begins. In Victoria and Queensland no teacher is allowed to give other than secular instruction in a school building. In Victoria, Queensland and South Australia the buildings may be used for any approved purpose out of school hours. The regulation in Victoria states that half an hour may be set apart in one or two school days in each week for religious instruction by persons other than state school teachers. Such classes must, however, be held either from 9.15 to 9.45 A.M., or from 3.30 to 4 P.M. No substituted secular instruction is to be given to the children who do not attend these classes. In New South Wales and Tasmania one hour a day may be set apart for the use of visiting clergymen or teachers of religion. The time, if not used for this purpose, is devoted to ordinary instruction. In Western Australia half an hour at any time in each day is available for special teachers of religion, subject to as little interference as possible with the ordinary work of the school. In none of the states is a child required to attend any religious lessons without the parents' consent. In South Australia the desire to arrive at a settlement of the vexed question of religious teaching in state schools led to the following resolution being carried in the House of Assembly 16 Dec. 1895: "That in the opinion of this House a poll of electors should be taken on the following questions: Do you favor: (1) The continuance of the present system of education in state schools? (2) The introduction of

Scriptural instruction in state schools during school hours? (3) The payment of a capitation grant to denominational schools for secular results?"

The poll was taken at the general election in April 1896, and resulted in the following answers: Question No. 1: Yes, 51,681; no, 17,819. Question No. 2: Yes, 10,280; no, 34,834. Question No. 3: Yes, 13,349; no, 42,007. Informal, 12,830. The referendum thus initiated has since been adopted for the solution of various questions in Australia.

Secular education does not satisfy the requirements of the Roman Catholic Church, which, therefore, in populous centres, maintains separate schools. In some of the states private schools are officially inspected. There are but few evening schools; little public requirement in this direction has so far been manifest. But continuation schools have been fairly successful in Western Australia.

Although, as has been seen above, primary education is chiefly a state function, this is not the case with secondary education. With few exceptions the secondary and high schools for both sexes are private or denominational establishments. The higher classes, however, in the state schools include subjects usually regarded as secondary. Provision is made by means of exhibitions, scholarships, etc., to enable bright and successful pupils from the state schools to continue their ascent, free of charge, up the educational ladder, through the high schools and at the universities. In New South Wales children who reach the highest class in the public schools may receive advanced instruction including Latin and French for 3d. a week, and the department maintains four high schools, two for girls and two for boys. The Sydney grammar school receives an annual grant from the state, as does also the high school in Perth. Queensland liberally subsidizes secondary schools. In South Australia there is an advanced school for girls which, although a state institution, is largely supported by fees. There is also in Adelaide a secondary state school for boys which is preparatory for the School of Mines and Industries and the Agricultural College. The distinctive feature of this school is that only half of each day is spent in the class rooms, during the other half the pupils receive practical instruction in the garden, the laboratory and the workshop. In Victoria extra and advanced subjects are taught in many of the public schools for a small fee. The Chambers of Commerce, the Bankers' Institute and the Incorporated Institute of Accountants hold periodic examinations in commercial and allied subjects which have a stimulating effect on this branch of education. There are private schools in each of the capitals which provide a commercial curriculum. Technical education, being a special need in a new country whose resources are only partially developed, is largely undertaken by the state. In the cities and in many of the towns, schools of design, schools of mines and industries, technological museums and workingmen's colleges abound. There are also numerous agricultural colleges. In several of the states technical schools have been built and equipped by private munificence.

In the capitals are art galleries containing many works by famous modern artists and sculptors. In connection with these are fine art schools where instruction in painting, sculpture, art, needlework and allied subjects reaches a high standard. These are as a rule controlled by boards, in some cases partly appointed by the government and partly elected. The University of Sydney was established in 1852 and that of Melbourne in 1855. South Australia followed in 1874 the example thus set and Tasmania founded a university in 1890, and recently Western Australia has established a university. These universities are supported by grants from the public chest, by public and private endowments and by fees. The Australian universities do not confer degrees in divinity; otherwise they resemble and are in no way inferior to those of the Old World. The universities in Adelaide and Melbourne grant degrees in music and each has a fully equipped conservatorium of music. In all the universities women are admitted to degrees and to the full privileges of graduates. The universities of Sydney, Melbourne and Adelaide grant degrees in medicine to both sexes. Consult Anderson, 'System of Education' (1901); Barff, 'The University of Sydney' (1914), and Peacock, 'System of Education' (1901).

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9. LITERATURE. Australian literature may be said to be a thing of the last half century. Previous to that writers were busy in Australia, but most of them were either of foreign birth or produced work that can scarcely, by any stretch of courtesy, be called literature. Even when writers of Australian birth, education and sympathies began to write, they practically always kept their faces turned toward London; for few native publishers cared to encourage native writers who had not first secured the approbation of some English publisher. This condition of literary affairs was quite natural given the conditions existing in Australia practically up to the close of the 19th century. The island continent was divided into seven distinct parts, which, far from being united in national sentiment, were cut asunder from one another as completely as though they had been separate political entities, as, to all intents and purposes, they were. This provincial spirit killed all national sentiment, without which a national literature is impossible. The educational system of the country was practically in the hands of foreign-born, and all the educational and literary influences at work in the various states of the island were European. So the writers of Australia but feebly echoed the voices of the master singers from the home land. Naturally such writers, foreign-born and educated, failed to feel, think and express themselves as Australians; nor could they have well been expected to when the natives failed to do so themselves.

But the growth of population, the increase of interstate communication, the drawing closer together of the separate state entities following the establishment of the Commonwealth, and the gradual increase in the powers

of the Federal legislature, coupled with the rapidly expanding interests of the country as a whole, all tended to create a sense of nationality which is sensibly reflected in the younger Australian writers. Provincialism exists still; but it is a provincialism from which all the bitterness of past local rivalries has disappeared. The localism has come already, in a few short years, to accentuate only the local color that marks each individualistic writer and to give a variety to Australian literature and journalistic work that has served to call the attention of the English-speaking world to the best of it for the past 20 years. Australian critics have strongly condemned this spirit of localism without apparently realizing that it is distinctly a different localism from that of the past, and that its leading note is more national than local. It is the same localism that animates Scott and Dickens and the brilliant younger literary lights of Scotland whose strongly reflected localism is their chief charm.

The early history of Australia was not favorable to literary development. The island was long used as a penal colony by Great Britain. Many of the convicts escaping, overran the southern part. This population was increased by sheep farmers and a few settlers on the coast who grouped themselves in small towns and villages around the ports. These settlements being all separated from one another they had no community of interests. The discovery of gold in 1851 attracted to the island a horde of adventurers who, while they added practically nothing to the national feeling, were the means of attracting attention to the country itself; and the following 10 years saw a very large increase in population throughout the southern and southeastern coast country. Many of the adventurers brought to Australia by the gold rush were educated men; and to some of these we owe the first serious attempts at literature in Australia, if we except a few local writers whose work is generally of a very poor character. The best of these was Barron Field who published at Sydney, in 1819, 'First Fruits of Australian Poetry,' and Lionel Michael, whose 'Songs without Music' was issued in 1857. Among other writers of this earlier literary period who sing in uncertain tones are J. D. Lang, Henry Parkes and W. C. Wentworth, the best of whom is Wentworth whose 'Australasia' is well known in Australia.

The real active, interesting, hopeful period of Australian literature began with Adam Lindsey Gordon (1833–72), who, though born in the Azores, came to South Australia, a young Oxford graduate in 1853. His father, an army officer, was of a literary turn of mind, and the boy, who was early well versed in the classics, was widely read in English literature before he left the university. He was an ardent admirer of Byron, whom he had already successfully imitated. In Australia Gordon was two years on the mounted police; and the seven following years he was a horse dealer and breaker and became champion steeplechase rider of the island. He was by temperament a man of action, and the more popular of his poems abound in movement, in the action of the life he led, which he liked for its activity and hated on account of its lack of social advantages and intellectual surroundings and opportunities. A legacy of £7,000 suddenly changed Gordon's life and surroundings and he became a member of the state legislature, where success came to him as a poet and cross-country rider. But the legacy was lost in speculation and with it went Gordon's business interests and his social position. In ill health and out of work he took his own life when apparently on the verge of material success. Gordon is the greatest of the Australian poets. His verse is spontaneous, musical, refined and natural. He has such a sensitive ear he rarely strikes a discordant note and he has the genuine gift of melodic form. His temperament is always superior to his surroundings and his literary touch is certain and self-possessed yet accompanied with emotional strength and restrained passion. But he is strongly touched with classical fatalism and sombre clouds ever hang over him constantly. His work naturally divides itself into three classes: Poems of action; strange, music-haunted poems of fatalism and brooding fancy; and poems blending action with his mood of brooding melancholy, in which he attains his highest note. Three volumes of poems, 'Sea-Spray and Smoke-Drift' and 'Ashtaroth' (1867), and 'Bush Ballads' (1870) constitute his published works. Henry Clarence Kendall (1842–82), the mad Australian poet who died in an asylum for the insane, is, after Gordon, the best of the native poets. He sings in a pure, spontaneous manner, in clear, lyrical tones, the glories of Australian forests, hills and plains. He loves her rivers and lakes and his verse is near to nature's heart. His published works include 'Songs and Poems,' 'Songs from the Mountains' and 'Leaves from an Australian Forest.' Like that of Gordon his verse is strikingly spontaneous and natural. Alfred Domett (1811–87), Premier of New Zealand, who, in 'Ranolf and Amohia' (1872) goes to the Maori for his subject and the inspiration for a forceful narrative poem, was highly praised by Longfellow, Tennyson and Browning. Charles Harpur (1812–68) has published several volumes of poems in which he sings, in a melancholic minor note touched with weird fancy upon which the bushland has placed its hand, the life of the back country in which his early manhood was passed. He is known as the bush poet. James Brunton Stephens (1835—), who published 'Convict Once' in London in 1871, was better known, until recently, than Gordon or Kendall, though he is inferior to them. He was quite a prolific writer. George Gordon McCrae (1833—) who wrote original, though rather unfinished, poems, on native Australian legends and stories; Alexander-Sutherland (1852—), D. B. W. Sladen (1856—), W. P. Reeves (1857—) Victor Daley (1858–1905), A. B. Patterson (1864—), Bernard O'Dowd (1866—) Will Ogilvie (1869—), Roderick Quinn (1869—), Edwin J. Brady (1869—) are among the best known of Australian poets after those already mentioned. Daley was a somewhat restless journalist who wrote much in both prose and verse for Melbourne, Sydney and other papers. He is idealistic, dreamily sensuous, suggesting often more than he says. He has been successful in picturesque, romantic poetry, love verse and humorous fancies. His work is cosmopolitan in tone and subject and occupies a high place

among writers of imaginative literature in Australia; for he is imaginative rather than realistic and has many and varied strings to his lute. 'At Dawn and Dusk' (1897) contains much of his best work, the greater part of which is still scattered through the files of many papers. Brady wrote songs of the sea with a swing to them that is distinctively Australian. Patterson shares with Henry Lawson the first place as popular poet to-day in Australia. Both are successful novelists as well as poets. Lawson especially is very versatile and always suggestive of Australia. There is scarcely a type or feature or class in the life of the Commonwealth of which he has not written. He looks upon the humorous side of life and he has given us a view of Australia distinct from that presented by other writers. His work is uneven; but it contains much that is excellent, while most of it is passable. His most characteristic book is 'While the Billy Boils.' Charles Allen Sherard ('A Daughter of the South,' 1889), J. B. O'Hara ('Songs of the South,' 1891), E. B. Loughran ('Neath Austral Skies,' 1894), Edward Dyson ('Rhymes from the Mines,' 1896), William Gay ('Sonnets,' 1896) and other poems, Melville Whyte, Kenneth MacKenzie, Patrick Maloney and Robert Richardson have also contributed to the making of the literary activity which began with the opening of the present century and still continues unabated in Australia.

One of the noticeable features of the present day literary movement in Australia is the prominent part being played in it by women writers. Louise Mack, a journalist, magazine writer and critic of note, is the leading spirit in this movement of the Australian woman toward literature. She has created a school of her own, distinctly feminine, and she has found scores of imitators, all of them inferior to herself in talent, imagination and vivacity. But Miss Mack seems to be growing out of her own school, which is not of the best, into better things and leaving the field to her followers and imitators, who appear unable to follow her. She gives signs of ridding herself of her newspaper mannerisms and giving rein to her innate delicacy, tenderness, artistic restraint and real strength of subtle imagination. 'Dreams in Flower,' her volume of published verse, though uneven in execution, is, at times, touched with an inspiration that promises well for the future. Among the two score or more of women in active literary life in Australia, Ethel Castilla, Jessie MacKay, Ethel Turner, Inez K. Hyland, Dora Wilcox Henly, Florence Gay and Dorothea MacKellar are most worthy of mention. All of them have done good work in some one field or another. Miss Turner has also written good juvenile stories.

At the head of the younger school of novelists in Australia is Arthur Hoey Davis ('Steele Rudd') who has, for several years, been one of the most discussed men in literary life in any country. He has broken away from the literary traditions of Australia so effectively that he has raised up an army of imitators. He writes vividly of the interior sections of the country where man fights an uneven fight against nature. He is a humorist and he lays the local color on with a strong brush. He treats, in a somewhat fantastic manner, but with noticeable individuality of style, a crowded gallery of native characters and types. He publishes a magazine of his own which has helped largely to increase his influence over the younger literary generation of the Commonwealth. The great charge laid at his door is that his pretended realism is the creation of his own vivid imagination and that he gives an untrue picture of Australian life and characters. Be this as it may, he has wakened literature and pulled it out of the rut in which it had gone since the days of Gordon, and he has turned the attention of native literary men to the great wealth of literary material at home, more full of interest, life and originality than any field heretofore entered in Australia during the present century. Prose, like verse, in Australia, has gone through a long apprenticeship of imitation and worshipping at foreign literary shrines. From 1840 to 1860 Australia went through a literary phase somewhat like the American dime novel, Indian and Wild West literature. Its literary aspirants for prose honors were, for the most part, but little superior to the writers of this American dime novel output. In Australia, however, they dignified the period with the name of school. This school helped to quicken the imagination and to create an interest in Australia, if not in things Australian. It dealt, in its first phase, with escaped convicts, immigrants with a shady past, bushrangers, gold diggers, highwaymen and the other picturesque and lawless characters who then made up a fair part of the life of the island. Henry Kingsley, an Englishman and brother of Charles Kingsley, after several years' residence in Australia, published, in 1859, 'The Recollections of Geoffrey Hamlyn,' which is credited with having had a strong salutary influence upon Australian fiction. L. B. Farjeon ('Grif,' 1869), Marcus Clarke (1846–81, 'For the Term of His Natural Life,' 1874) are among the few names of this early literary movement worthy of remembrance. Farjeon depicted vividly and truthfully the night life of Melbourne, while Clarke handled the convict system in a manner that compelled attention, not only at home in Australia but in the countries of Europe, into the languages of most of which his novel has been translated. Charles Alexander Brown is the best of the Australian novelists. Under his pen name of 'Rolf Boldrewood,' he has written a series of novels which show the life of Australia of the latter half of the 19th century in a vivid and interesting manner. 'Robbery under Arms' (1888) won for him a reputation as a novelist throughout the English-speaking world. He has more than a dozen works of a like nature to his credit. A. B. Patterson has also ventured into this field, the crudeness of the life of which he delights in depicting. Louis Becke, too, finds the unpleasant and immoral phases of Australian life to his taste. Guy Boothby ('The Beautiful White Devil' and 'Dr. Nikola,' 1896), Walter Jeffrey ('By Reef and Palm,' 1896, 'Pacific Tales,' 'Child Life in the Southern Seas,' 1897, and 'The Mutineer,' 1899) are the legitimate forerunners of the modern Australian school of fiction headed by Davis, who has put on the appearance, at least, of making true and realistic pictures of representative life in the interior of Queensland. He has done Australian literature the great service of ridding it of the crudities and questionable pic-

tures which the previous native novelists were but too prone to present.

Mrs. G. F. Cross (Ada Cambridge 1854—), though not a native of Australia, has so identified herself with its literary life that she may justly lay claim to being its greatest woman story teller. She has close upon a score of novels to her credit. They are cosmopolitan in subject and vigorous in treatment. In the 'Three Miss Kings' she depicts vividly life in the bush country. Mrs. Campbell Praed (1851—) has been even more prolific than Mrs. Cross, her published novels being well over a score. Though she has been, in a sense, popular, here stories, owing to their extreme pessimism, are not pleasant; but they show power of character delineation and character painting; and her facility of invention seldom limps. Mrs. Aeneas Gunn has lately achieved an international reputation as a novelist and her works have become popular in the United States, England and Canada. One of her most characteristic novels is 'We of the Never Never.'

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10. RELIGION. There is no established Church in Australia. All religions are now on an equal footing so far as the governments are concerned; grants in aid were formerly given by the leading religious bodies, but one by one the states relinquished the practice. South Australia led the way in this abolition in 1851, a few years after the foundation of the colony. Queensland, in 1860, shortly after the assembling of its 1st Parliament, limited future payments to the clergy actually in receipt of grants; New South Wales followed suit in 1862 and Victoria in 1875. Western Australia voted periodical subsidies until 1895, when future annual payments were commuted by the distribution of two grants of £17,715 each in that and the following year among the Anglicans, Roman Catholics, Wesleyans and Presbyterians, which are the only denominations that have received state aid in recognition of their religious work. The members of these four Churches constitute the great bulk of the population and their relative numerical strength has remained almost constant for the last 30 years. The Commonwealth is debarred from legislating in respect to religion. Clause 116 of the Constitution Act provides that: "The Commonwealth shall not make any law for establishing any religion, or for imposing any religious observance, or for prohibiting the free exercise of any religion, and no religious test shall be required as a qualification for any office or public trust under the Commonwealth." In the convention which framed the Federal instrument after long and earnest debate the words "humbly relying on the blessing of Almighty God" were inserted in the Preamble to the Act in recognition of the deeply religious sentiment of the people. At the census of 1911 the numbers of adherents of the various denominations in the Australian Commonwealth were given as follows:

Church of England	1,710,443
Roman Catholic	921,425
Presbyterian	558,336
Methodist	547,806
Baptist	97,074
Congregational	74,046
Lutheran	72,395
Salvation Army	26,665
Various other Christian denominations	266,224
Total	4,274,414
Non-Christian religion	36,785
Indefinite	14,673
No religion	10,000
Declined to state	83,000

Australia was originally included for ecclesiastical purposes in the province of Canterbury and up to the year 1836 was attached as an archdeaconry to the diocese of Calcutta. For 15 years after the foundation of New South Wales the only denomination recognized by the government or possessing a minister was the Church of England. There is now a general Synod of this Church which meets every five years under the presidency of the archbishop of Sydney, who has the title of primate of Australia, although each state preserves its autonomy in church affairs. Melbourne and Brisbane also have archbishops. There are six dioceses in New South Wales; five in Victoria; four in Queensland, together with that of New Guinea; and two in Western Australia. There is also the diocese of Adelaide in South Australia and of Tasmania. The Roman Catholic Church occupies, so far as numbers are concerned, the second place in each of the states, with the exception of South Australia, where the Methodists are numerically stronger. Its organization in Australia as elsewhere is superb. At the head of the Church stands the archbishop of Sidney. There are archbishops in Melbourne, Brisbane, Adelaide and Hobart, and 14 bishops in the six states. Until 1834 Australia, so far as the Roman Catholic Church is concerned, was under the bishop of Mauritius. Sydney was in that year constituted a see; eight years later the prelate was invested with the title of "Archbishop of Sydney and Vicar Apostolic of New Holland." In 1885 the archbishop of Sydney was created a cardinal and placed at the head of the Roman Catholic Church throughout Australasia. In 1876 Melbourne was made an archidocese as were also Adelaide and Brisbane in 1887, and Hobart a year late. The cathedrals of Saint Mary in Sydney and Saint Patrick in Melbourne are especially magnificent structures. The Roman Catholic Church takes a prominent part in furthering social and industrial legislation and in temperance work. The Wesleyan Methodist Church was established in New South Wales in 1812, at a class meeting attended by 12 persons. Up to 1855 this Church was regarded as a mission, but in that year it was constituted an affiliated conference. In 1873 the Australasian Wesleyan Church was raised to the rank of an independent conference. On 1 Jan. 1902,

the Wesleyan Methodist, the Primitive Methodist and the United Methodist Free Churches of Australia and New Zealand were united under the name of the Methodist Church of Australasia. In South Australia this Church includes 25 per cent of the whole population and throughout Australia its members form a compact, enlightened and progressive body, which has exercised a preponderating influence in promoting temperance legislation and measures tending toward a higher plane of morality. The Presbyterians erected in 1810 one of the first places of worship in New South Wales. The Presbyterian Churches in all the states are united under the title of the Presbyterian Church of Australia in a General Assembly which meets every year in the capital cities in rotation. The Church in each state, however, acts independently in local administration and is autonomous so far as property is concerned. There is a Union of the Congregational Churches in each state federalized in the Congregational Union of Australasia. Thus pervading the Churches and leading to interstate Unions is witnessed the same synthetic spirit which was materialized in Australian Federation. By this means strength is acquired without the sacrifice of local liberty, for a Federal union combines firmness with flexibility.

The youngest and one of the most active religious bodies in Australia is the Salvation Army. It started in South Australia in 1880 and two years later officers were sent from Adelaide to organize forces in Victoria, New South Wales and Tasmania, and in 1886 to Queensland; operations in Western Australia were commenced in 1891. At first the officers of the Army met with much ridicule and some ill-treatment but the earnest and effective manner in which they grappled with the problems of social reform soon reconciled the public to their methods. Persecution gave way to popularity, and the work of the Army is now applauded by all classes. The Prison Gate Brigade reclaims many criminals, and does such good service in diminishing crime that several of the state governments give a grant in aid of its operations. The headquarters of the Army are in Melbourne and the officer commanding in Australia has the rank of a commissioner. There are colonels and brigadiers in each state.

The several churches in Australia are animated by those friendly and tolerant sentiments which are the natural offspring of freedom. An interchange of pulpits is not infrequent. On Empire day in 1906 a special service was arranged at Saint Paul's Cathedral, Melbourne, in which the president of the Methodist Conference and the minister of the principal Presbyterian Church took part.

JOHN ALEXANDER COCKBURN,
Formerly Minister of Education in South Australia.

11. INDUSTRIES AND COMMERCE.

Manufactories.— For many years Australia relied chiefly on its raw products for its wealth, but recently steady progress has been made with its manufacturing industries, and at the present time over 250,000 men and more than 82,000 women find employment in what are ordinarily termed factories, as well as a large number of others in smaller establishments.

The most rapid increase in the manufacturing industry has taken place during the past few years — in fact between 1894 and 1917 the hands employed increased from 133,631 to 320,922, an increase of nearly 10,000 per annum, as compared with an increase of only 2,800 per year during the 10 years previous to 1894, the growth of the factory employees being proportionately far greater than that of the population.

As regards the manufacturing industry generally, the population of the continent is at present hardly sufficient to maintain a large manufacturing population, while its distance from other market places is at some disadvantage as regards the export of manufactured products. The total horse-power of machinery used in the factories amounts to over 440,000, the increased use of electricity in recent years being accountable for a rapid addition in such power.

The following table shows the number of establishments and the hands employed in each state of the Commonwealth in factories and works employing four hands and over:

1915	New South Wales	Victoria	Queensland	South Australia	West Australia	Tasmania
Establishments	5,268	5,413	1,838	1,323	1,301	623
Employees	116,462	113,834	42,363	26,874	10,981	9,784

In Queensland the two principal manufacturing industries are sugar refining and meat preserving, and of the total number of people employed, about 12 per cent find employment in these two industries.

The total output of all factories in Australia, exclusive of those engaged in the production of butter, cheese and bacon, figures of which are included in the pastoral industry, amounts to £166,405,923, of which £99,778,884 represents the value of material and fuel used, and about £66,627,039 the value added in the process of treatment.

The following table gives the class of industries which give employment to people in the Commonwealth:

Class of Industry	Hands employed
Treating raw material the product of pastoral pursuits	9,495
Oils and fats, animal, vegetable, etc.	2,091
Processes in stone, clay, glass, etc.	13,794
Working in wood	31,646
Metal works, machinery, etc.	68,839
Connected with food and drink, etc.	49,882
Clothing and textile fabrics and materials	84,237
Books, paper, printing and engraving	26,013
Other industries	51,104
Total	337,101

Tanning, fell-mongering and wool scouring afford the largest amount of employment among the industries in class 1, and this can be readily understood, seeing that the pastoral industry is still the greatest in the Commonwealth.

In class 2 the manufacture of soap and candles is increasing rapidly.

In class 3 the manufacture of bricks and tiles is the most important, about 65 per cent of those engaged in this class being employed in that industry.

In class 4 it can be readily understood that with the immense forests of valuable timber, the saw mill is the most important of wood-working establishments, and about 70 per cent of those employed in that section are in saw mills.

Class 5 included a great number of persons employed in the engineering works of the respective state government railway and tramway workshops. Also workers in smelting establishments for the extraction of ore, though these employed in quartz batteries are not classified as factory hands in Australia. There are several important establishments for the manufacture of agricultural implements, and at Gawler, in South Australia, and in Melbourne, the capital of Victoria, important agricultural implement works have been founded. To an Australian firm is due the credit of inventing that great labor-saving appliance, the "Complete Harvester."

In industries connected with food and drink, butter, cheese, meat preserving, sugar mills and breweries employ a great number of hands, while flour mills, aërated water factories, biscuits and other articles required for local consumption also employ a great number of persons.

Factories connected with clothing and textile fabrics offer more employment than any other section, and here the females employed largely outnumber the males. Victoria shows the greatest development in this industry, and during the last few years the manufacture of wool has made considerable progress in the various states.

Speaking of wages generally, Australia pays its employees high wages compared to other countries, while the genial climate and general healthy conditions of life make living cheap compared to other countries of the world.

During the last few years a system of industrial legislation has come into force in most of the states, which brings about better conditions of work, cleanliness, air space, sanitation, etc. Australian factories, as a rule, are well built and roomy. The day's work is generally limited to eight hours with extra payment for overtime in cases of need. Wages boards have also been appointed for many of the principal industries, and to prevent strikes and lock-outs courts of conciliation and arbitration have been established.

Taking the Commonwealth as a whole, the latest records show that in industries controlled by wages boards the average earnings of male workers, 21 years old and upward, is £2 15s. 7d. per week, and of females, £1 7s. 5d. per week, the average wage in industries not so regulated being about 2/ per week less.

Pastoral Industry.— The pastoral industry plays the most important part in the resources and wealth of Australia. At the close of 1915 Australia had 69,693,375 sheep, 9,993,743 cattle, 5,392,566 horses and 758,962 pigs.

Nothing is more marvelous than the progress of the pastoral industry. In the year 1800 there were only 6,124 sheep, 1,044 head of cattle, 203 horses and 4,017 pigs in the whole of Australia, but it is since 1850 that the greatest progress has been made, and from that date the value of the wool alone which has been exported has amount to £880,000,000 sterling.

The first sheep imported were from the Cape of Good Hope, and in 1823 and 1825 further lots of Spanish sheep were introduced. In some respects the climate of Australia changed and improved the character of the Spanish fleece. The wool became softer and more elastic and increased considerably in length. The average weight of a fleece has increased remarkably, and while in 1861 the average weight of a New South Wales fleece was only 3.28 pounds per sheep, the present average weight is 7.3 pounds.

In recent years there has been a tendency to divide the sheep into smaller flocks. In New South Wales for instance there are 17,361 sheep owners as compared with 14,033 10 years previous, while the average size of a flock is now 1,650 as against 4,050 at a former period. Of the total number of the sheep in Australia about 95 per cent are merinos. On the coastal districts, however, where merino sheep do not do so well, the rearing of cross-bred and long wool sheep is increasing and these are specially valuable for the meat they produce. It is interesting to note that at the present time Australia carries one-fifth of the total sheep in the world.

The export of wool brings an immense amount of money to the Commonwealth and in 1913 returns for the Commonwealth were £26,277,000.

The production of wool for the fiscal year ending 30 June 1916 was large and the prices set new records for Australasia. The number of bales exported from the different states of the Commonwealth was as follows: New South Wales, 840,515; Victoria, 342,476; Queensland, 258,122; South Australia, 92,654; Western Australia, 73,564; and Tasmania, 11,928. Shipments from New Zealand amounted to 510,656 bales, making a total for Australasia of 2,129,915 bales, against 2,137,702 bales for 1914–15. There was a decrease of more than 12,000,000 sheep in the Australasian flocks during the year. The gross proceeds from the sale of wool in Australia and New Zealand were $145,525,537, an average of $80.50 per bale, in 1915–16, compared with $96,077,100, an average of $62.19 per bale, in 1914–15. The average is the highest yet realized in the colonial market. When the British government took over the remaining Australian wool clip in November 1916, there was doubt whether the high prices would be maintained, but the reports of the appraisers allayed this. The value of Australian wool purchased by Great Britain will exceed $100,000,000. Although the removal of the embargo permitted shipments of burry wools to America, it is likely that the demands from Great Britain will require practically the entire clip.

Cattle.— Owing to the more profitable character of sheep farming, cattle breeding in the Australian states is, with the exception of Queensland, second to that of sheep. The fol-

lowing table shows the number of cattle in the various states at the end of 1916:

State	
New South Wales	2,405,000
Victoria	1,043,604
Queensland	4,780,893
South Australia	226,565
West Australia	821,048
Tasmania	169,575
Northern Territory	483,961
Total	9,930,646

Horses.— Considerable attention has been paid to the breeding of horses and at an early period the stock of colonial-bred horses was improved by the importation of Arabian and other breeds. The following table shows the number of horses in the different states in 1916:

State	
New South Wales	720,000
Victoria	493,779
Queensland	686,871
South Australia	253,333
West Australia	163,006
Tasmania	41,422
Federal Territory	19,957
Total	2,378,368

There is a considerable demand in India for Australian horses and as a rule between 6,000 and 7,000 are exported annually to India, valued at from £80,000 to £85,000.

Angora Goats.— Considerable attention has been given during the last few years, especially in Queensland and New South Wales, to the production of mohair and considerable numbers of pure-bred angoras have been imported from the United States. The goat thrives admirably in the warm dry climate of Australia and it seems likely that in the near future the export of mohair will show considerable increase. At the present time there are about 262,000 goats depastured in Australia.

Camels.— In some of the states camels are employed for the carriage of wool and other produce. In the Commonwealth as a whole the number of camels is more than 10,000.

Pastoral Returns.— The annual return from the pastoral pursuits in 1915 was £60,265,000, of which total sheep contributed about 58 per cent. The greater part of the sheep industry is, of course, the return from wool and skins. The value of wool consumed locally is not more than £250,000.

Frozen Meats.— A rapid increase in live stock in Australia in favorable seasons makes the question of disposing of the surplus material of serious consequence. In 1882 the first shipment of frozen mutton from Australia to Great Britain was tried. In 1916 £9,116,663 worth of frozen meat, including £1,270,707 worth of frozen mutton and £724,624 worth of hares and rabbits were exported from Australia over sea.

Queensland exports large quantities of chilled and frozen beef, the total amounting to about £1,000,000 worth annually. Much of this is sent to the other states and is not included in the oversea exports. New South Wales exports chiefly frozen mutton, which varies in value from about £200,000 to £500,000 annually. Victoria also exports large quantities of frozen mutton and beef, while South Australian lambs are highly prized in the British markets. The export of canned meat was valued at £500,955.

Dairy Farming.— The introduction of the factories system at convenient centres in Australia has caused rapid extension in this industry. Immense quantities of butter are now exported to Great Britain, in 1916 the export amounting to £1,117,629 sterling. The total amount of the dairy products of Australia for 1916 was valued at £21,562,000.

Forestry.— Australia is chiefly famous for its hardwood timbers, the export of which is now a considerable industry. In 1916 the total exports from Australia amounted to £396,337, of which West Australia exported the greater part. The present annual value of the timber industry of the Commonwealth, that is of the rough timber as it leaves the forest saw mills, is about £3,000,000 sterling. In West Australia alone the forests of marketable timbers are estimated to cover about 21,000,000 acres. The governments of all the states have a number of reserves where the young timber is conserved so that the source of supply can be maintained.

Jarrah is the chief timber exported, its principal use being for wood-blocks, piles, railway sleepers, etc. The wattle tree grows well in most parts of Australia, from the bark of which large quantities of tanning material are produced. There are various species of eucalyptus from which is distilled the famous eucalyptus oil which has a considerable value for medicinal purposes. Some of the fine-grained woods are also very beautiful and much used for decorative purposes. The karri is probably the finest tree of the Australian forests, and sometimes run to over 30 feet in circumference at three feet from the ground and up to 150 feet from the ground to the first branch. Other prime timbers are ironbark, tallow wood, spotted gum, grey box, mahogany, blackbutt, etc. Besides hard woods there are beautiful cabinet woods, viz., cedar, rosewood, redbean, silky oak, blackwood, etc.

Agriculture.— Judging by the experience of the past 30 years, Australia appears to be on the threshold of vast agricultural developments. Up to 1871 only 2,345,922 acres were under crop in the Commonwealth, but in 1916 this had increased to 15,651,974 acres. Of the cultivated land 90 per cent lies within the borders of New South Wales, Victoria and South Australia. The following table shows the area cultivated in the various states:

State	Acres, 1915
New South Wales	4,808,627
Victoria	7,070,000
Queensland	650,000
South Australia	4,612,274
West Australia	1,867,547
Tasmania	333,334
Federal Territory	5,143
Total	19,346,925

As in most new countries where the pioneer farmer needs a quick return from his land, wheat is the principal crop and nearly 67 per cent of the cultivated land is sown to wheat. The area under wheat for grain in the various states in 1916 was as follows:

State	Acres
New South Wales	2,758,024
Victoria	3,680,000
Queensland	93,703
South Australia	2,502,630
West Australia	1,734,117
Tasmania	48,642
Total	10,817,116

In 1915 the yield of wheat for the Commonwealth amounted to 125,000,000 bushels. The other crops of most importance are hay, oats and maize.

The Commonwealth requires about 30,000,000 bushels of wheat annually for home consumption and seed and a production of 125,000,000 leaves about 95,000,000 bushels annually for export.

The average yield of wheat in Australia may be taken at about 10 bushels per acre. This appears low judging by the standard of many other countries, but a bare statement of average is misleading, as in Australia the cost of production is relatively very low. In ordinary districts the expenses of ploughing, seed and sowing and harvesting the wheat amounts to from 15/ to 20/ per acre, so that a yield of 10 bushels at 3/ a bushel means a return of from 10/ to 15/ an acre out of which to pay the other expenses.

In South Australia the conditions of cultivation are even more favorable than the above indicates, and with a smaller yield, wheat growing is bound to be very profitable. The present comparatively low yields are largely due to the fact that immense areas are put under crops by individual farmers. In consequence, the cultivation and harvesting methods are not carried out so thoroughly as in older countries of the world. With smaller areas and better farming, far higher averages will, it is believed, be obtained in the future. The following tables show the average area and yield of some of the other principal crops:

West Australia and South Australia. By sinking artesian bores supplies of water are brought to the surface from underground sources which exist in the Tertiary drifts and the Cretaceous beds.

In New South Wales one of these wells has a daily flow of 1,750,000 gallons, the depth of the bore being 2,029 feet. Over 50 artesian bores have been successfully sunk in South Australia, the greatest daily flow amounting to 1,200,000 gallons. These bores give excellent water for stock purposes and are also used in many cases for irrigating crops.

Mineral Resources.—Most metals of economic value are found in Australia. Gold is found in all the states and in 1823 the first discovery of the precious metal was made. In 1851 and 1852 important discoveries were made in New South Wales, Victoria, South Australia and Tasmania and attracted a rush of population. A little later gold was found in Queensland and the last of the states in which extensive deposits were found was West Australia. So important did these deposits prove that in 1905 the output of West Australia was more than equal to all the other Australian states together.

The following table shows the gold won in Australia up to the end of 1915 and the return for the year 1915:

	Total Yield, £	1915 Ounces
Total	572,487,653	8,270,339

Silver.—Australia is rich in silver and it is found in all the states either alone or in the form of sulphides, chloride, bromide, iodide, chloro-bromide of silver and antimonial and arsenical ores and argentiferous lead ores. In the latter the largest deposits of metal are found.

Prior to 1882 the output of silver in Australia was small, but with the opening up of the Barrier mines at Broken Hill, close to the boundary of New South Wales and South Australia, rapid advances took place. The following table shows the output of silver and silver lead in Australia up to the close of 1915 and for the year 1915:

	Silver £	Silver-lead £
Total	82,266,333	3,514,254

Copper.—The production of copper in Australia in 1915 amounted to £3,035,890.

Tin is also found in payable quantities in many parts of Australia, the production in 1915

ACRES, 1915–16

	Maize	Oats	Hay	Potatoes	Sugar cane	Vines
Total for Commonwealth	339,781	724,576	3,530,180	148,328	164,449	60,985

AGRICULTURAL PRODUCTION

	Maize	Oats	Hay	Potatoes	Sugar cane	Wine 1912–13
	Bushels	Bushels	Tons	Tons	Tons	Gallons
Total for Commonwealth	8,445,561	16,603,281	5,620,311	357,614	1,310,264	2,875,300

Large areas are also under orchards in the various states of the Commonwealth, the total being 216,000 acres. Victoria heads the list with 67,000; New South Wales 51,000, and South Australia 24,000. The export of apples, oranges and dried fruits to Great Britain has been commenced and promises to develop into an important industry.

All the governments give considerable attention to agricultural education and have established agricultural colleges and experimental farms where practical and scientific agriculture is taught.

In most of the states also arrangements are made by the government to advance money to assist farmers at low rates of interest.

Irrigation.—The necessity for providing water for stock and irrigation in the dry parts of Australia induced the respective governments to spend a good deal of money on water conservation and artesian boring. Cretaceous beds extend over large areas of New South Wales,

amounting to £806,641. Iron is distributed throughout the Commonwealth and at Lithgow, in New South Wales, where iron and coal deposits lie alongside each other, a commencement has been made to smelt the ore. Tasmania has enormous deposits situated near the Blyth River. Other minerals widely diffused throughout Australia are antimony, bismuth, manganese, platinum, tellurium, lead, wolfram and a number of earth colors. The annual production of such other minerals amounts to about £1,000,000.

Coal.— Coal was first discovered in New South Wales in 1797. Since that time it has been proved that nature has bountifully supplied Australia with mineral fuel. Black coal forms one of the principal mineral resources of New South Wales. The total output of coal in 1915 reached £4,277,592.

Brown coal or lignite occurs principally in Victoria but it is much inferior to the black coal. Good coal has been found in West Australia, while in Queensland the extent of the coal fields is practically unlimited — over 24,000 square miles of coal measures having already been explored. Tasmania also has important carboniferous formations.

Marble of high quality is found in many parts of Australia, while the finest opal known is obtained in the Upper Cretaceous formation near Wilcannia, New South Wales. The output of opals from Australia up to 1913 amounts to £1,534,895. Other gemstones, including emeralds, sapphires, rubies, etc., are found in various parts, while diamonds are found in New South Wales, Victoria, Queensland and South Australia, though only in the first named are the diamond drifts worked commercially.

Commerce.— The external trade of Australia is increasing rapidly as the following table shows:

Year	Imports	Exports	Total trade
1861.....	£17,562,960	£17,399,656	£34,962,616
1881.....	29,031,131	27,528,583	56,559,714
1901.....	42,433,811	49,696,172	92,129,983
1905.....	38,407,579	56,750,347	95,157,926
1908.....	49,786,798	64,311,058	114,097,856
1913.....	79,749,000	78,572,000	58,321,000
1914.....	70,693,200	62,855,200	133,548,400
1915.....	67,640,000	61,280,000	128,920,000
1916.....	79,740,000	81,720,000	161,480,000

The external trade of the Commonwealth amounts to £32.19 per head of population, which is nearly four times that of the United States and considerably greater than that of the United Kingdom.

Of the total trade 52 per cent in 1913 was with Great Britain, 12 per cent with other parts of the British empire and 36 per cent with foreign countries. The trade of Australia shows a considerable diversion in recent years from Britain to foreign countries. In fact nearly one-third of imported goods are now of non-British origin as compared to one-fourth a few years ago, and of the exports over two-fifths are sent to non-British countries compared with one-tenth in 1885. The chief cause of this is the establishment of direct and rapid communication between Germany, France, Belgium, Japan and the United States with Australia.

In the exports the same tendency is noticeable, in 20 years the percentage to Great Britain having fallen from 74.91 per cent to 44.30 while exports to foreign countries have increased to 43.67 per cent.

Shipping.— In 1913 the total number of vessels in the oversea trade entering and clearing Commonwealth ports was 3,985, of 10,601,948 tons.

Since 1904 Australian shipping has increased considerably, both in the total tonnage entered and cleared and the number of vessels engaged in oversea commerce. This progress has not been so great, however, as to materially alter the balance of trade. Australia being chiefly an agricultural country, no great or sudden rise in its exports is to be expected. Yet, were it not for this fact, the general rise in shipping — and especially the increase in the number of vessels clearing and entering in recent years — would be but normal and in keeping with the country's general advance.

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SIR TIMOTHY AUGUSTINE COGHLAN,
Agent-General for New South Wales.

12. FINANCE. In matters of finance, as well as in many other things, Australia presents a most interesting field for study. Sprung from a splendid body of pioneers, who had been brave and enterprising enough to quit the old home-land, with all its tender associations, the colonists have wrought wonders. Untrammeled by any undue preference for the old ways and with ample scope for bold, not to say audacious, experimenting, the spirit of enterprise, inherent from their fathers strong in them, the second generations of the settlers, who are the Australians of to-day, have striven to put into practice, and by no means without success, some theories which have elsewhere remained merely theories. In their systems of land settlements, their state ownership of such undertakings as railways, tramways, water works, etc., and in schemes of taxation, to say nothing of other matters of finance, they have sometimes discarded precedent and have no reason to be ashamed of the results which they have to show for their enterprise and fearlessness. Complicated as are, in some respects, Australian questions, through the existence, at one and the

same time, of a dual citizenship, every person owing allegiance to his own individual state and also to the broader Commonwealth government, a very little care will enable a complete view to be taken of Australian finance, including both those figures relating to the Commonwealth, or national, and to the state or provincial governments. The 5,000,000 people of the Commonwealth occupying the great island continent of Australia and the adjacent small one of Tasmania, with an area in all, or as nearly as possible, 3,000,000 square miles, having, for national purposes, united under the Commonwealth Constitution Act, are still, in respect of all but certain specified matters, citizens of one or other of the six states of New South Wales, Victoria, Queensland, South Australia, Western Australia and Tasmania. So far as their finances are concerned it is necessary to remember that to the Commonwealth are assigned very large powers of taxation, which, however, up to 1914 were only exercised in respect of customs and excise, the whole revenue from which is collected by the Commonwealth, the balance, after meeting its own necessaries, was handed over to the states, in proportion to the amount of the duties derived in each state. In 1910 arrangements were made with the states in lieu of the above provision that 25/ per head of the population should be returned to the states. The Commonwealth controls all posts, telegraph and telephones, as well as all military and naval defenses, and also several other important departments of state, but the finances and statistics are unaffected by these matters, as in the case of all of them where there is a Commonwealth control, state control ceases. In taxation, however, if it were attempted to show the total for Australia by adding to the total for the Commonwealth those for the states, the result would be wrong; just as would be any attempt to get the total revenue and expenditure for Australia by adding Commonwealth totals to those of all the states, because of the portion of the customs and excise revenue which, being first collected by the Commonwealth, is afterward paid over to the states and so would appear twice in the totals.

In this statement care will be taken to show all the figures once, without any duplication whatever. The figures given will, unless otherwise stated, be from the latest volume published by the Commonwealth government statistician, Mr. G. H. Knibbs, C.M.G.

The customs and excise revenue for the year ending 30 June 1914 was collected under the following heads:

Customs	
Stimulants	£2,810,222
Narcotics	1,175,404
Sugar	209,375
Agricultural products and groceries	1,002,363
Apparel and textiles	2,514,170
Metals and machinery	1,672,125
Oils, paint and varnish	310,847
Earthenware, etc.	426,134
Drugs and chemicals	122,960
Wood, wicker and cane	555,843
Jewelry and fancy goods	272,214
Leather and rubber	470,382
Paper and stationery	234,504
Vehicles	343,633
Musical instruments	166,059
Miscellaneous	330,548
Other receipts	35,954
Total customs	£12,652,737

Excise	
Stimulants	£1,213,749
Tobacco	927,293
Sugar	179,149
Miscellaneous	5,142
Total excise	£2,325,333
Total customs and excise	£14,978,070

The Commonwealth up to 1910 had no revenue from any other form of taxation besides customs and excise. A land tax was then imposed which in 1914 brought into the revenue £1,609,836. The total revenue, including postal, patents, trade marks, coinage, etc., amounted in 1914 to £21,741,775. A progressive income tax was passed in 1915 to meet war expenditure. This is as high as 5/ in the pound on incomes of £6,500 or over; an excess tax on profits has also been imposed.

The Commonwealth was to a large extent a tax-gatherer for the states up to 1910, the Constitution requiring it for the first 10 years at least to return to the states or to pay on their behalf, as interest or principal on state loans, not less than three-fourths of the total income from customs and excise. This provision was adopted in order to avoid dislocation of the state finances through the transfer of this revenue from the states to the Commonwealth, and also to restrain the Commonwealth Parliament from mopping up all the revenue from customs and excise by launching out on new and costly enterprises which might leave the states in an awkward financial position. The Commonwealth Parliament as it has set its face sternly against borrowing, even for public works, pays for all that is necessary out of surplus revenue. It is proposed in influential circles to federalize the state loans to such an extent as would finally absorb the revenue now returned year by year to the states, so as to remove the present interdependence of Commonwealth and state finance. The expenditure of the Commonwealth is narrowed down to a very few items. We have the cost of the departments transferred from the states to the Commonwealth and now controlled by it, such as the customs and excise, posts, telegraphs and telephones, military and naval defenses, etc. To these are added the cost of the Commonwealth machinery of government, including the departments of the governor-general, the ministers of state, and the legislature, together with the judiciary. The outlay on public works and buildings for the year 1914 was £2,576,000 and the total expenditure was £15,458,776.

The revenue and expenditure of all the states forming the Commonwealth for the year ending 30 June 1914 was as follows: Revenue, £47,269,039; expenditure, £46,551,907. Nearly one-half of the total revenue of the state is derived from "public works." This represents the earnings of the railways, tramways, harbor works and water works, together with other lesser undertakings, the construction of which has been the main factor in building up what at first sight appears to be the huge debt of Australia. It may, however, be noted that the public works not only aid very greatly in the development of the vast areas of the unoccupied Crown lands in Australia, but they also produce a large annual revenue, which may

well be set off against the annual interest charge, as the value of these permanent assets are set off against the debts themselves. The works include nearly 18,000 miles of railways, which cost £177,000,000 up to the end of 1914, the latest year for which the details are obtainable, and for that year they earned, over and above working expenses and upkeep, the sum of £6,887,000 toward interest on the loans raised to pay for them. As the country through which they pass develops their earnings must increase. The item land sales and rents is much lower than in the past years, as the present policy of all the states is to encourage settlement by leasing land on very long leases, with or without right of purchase, so as to assist people with little capital, rather than to sell land for cash. In many cases the purchase money is spread over as many as 20 years, all payments going off the purchase money, so as to aid would-be cultivators who are short of funds to make a start. The provision of such conveniences as roads, bridges and schoolhouses absorb practically all the proceeds from the land for several years after it is first leased, so that the states are by no means living on their capital. The lands which once returned no revenue at all are, by these means, being gradually developed and made to produce loading for the railways and business for the harbors as well as assets and income taxable by the treasurers. The taxation differs in the several states, though most of them now levy on the estates of deceased persons in proportion to the size of the bequests left and to the degree of relationship between the testator and the legatee, the larger bequest and the more distant relation paying the higher rate. There are also, in most states, taxes on income and on "unimproved land values" that is to say on the capital value of land less the value of improvements thereon. The principle of progression in taxation is recognized in the Commonwealth and the different states, not only in succession duties, but in income and also in land values taxation. The usual distinction is observed between income derived from personal exertion, and therefore dependent upon the life and health of the earner, and that derived from investments or property, which is independent of personal effort. The rate of tax is higher on the income from property than upon the produce of personal exertion. There is, too, the further graduation according to the amount of the income. The land values taxation levied in the Commonwealth and in the states is on the value of the land after deducting the value of improvements thereon. It is, therefore, much heavier on city and suburban than on country land, area for area. There is also an extra tax of 20 per cent on the first tax if the owner of the land be not resident in the state. The miscellaneous receipts call for no special remark. The total revenue looks very large, but it needs to be remembered that altogether apart from the postal and telegraphic receipts, which appear not in the state, but in the Commonwealth accounts, as do also all figures relating to military and naval defense nearly one-half of the total is for services rendered to the people by means of public works, and altogether outside the functions (ordinary) of government, as commonly understood. On this account it cannot be said that Australians are burdened by the contributions they make to revenue, even though they pay in all, to Commonwealth and states, £9 to £12 per head per annum. The further taxation levied by local governing bodies for purely local expenditure, such as road maintenance and sanitation, is not large. The figures for Western Australia are abnormal on account of the rapid development of the gold fields and the resulting preponderance of highly paid adult males in the population, consuming highly dutiable goods. The expenditure of the states would be absurdly high were it not for the fact that it includes, to the extent of 56 per cent of the whole, provision for the working of the railway and the payment of interest and the repayment of debts. These charges are not in any true sense "costs of government." They must be considered in relation to special income appearing on the other side of the account. That 7 per cent of the expenditure is for education is indicative of the general trend of affairs in Australia and of the high ideals cherished. Of course it needs to be remembered that at the present stage settlement is sparsely spread over a huge territory, and that the costs of administration would be slightly increased, if at all, if there were three or four times the number of people on the land that there are to-day, while the revenue would be largely multiplied. It is area rather than population which, under certain circumstances, determines expenditure, and these circumstances exist in many parts of Australia to-day. The Australian of the present is fully determined not to allow extravagance in public expenditure, and no blunder in public life is more speedily punished by the electors. The expenditure of the states of course includes all the cost of legislative machinery, with the salary of the state governors, and the members of the state Parliaments, and also all the charges connected with the administration of all the departments, such as police, public health and education, together with the oversight of an elaborate system of local government, and each state in its turn deals with a wide area of purely local concerns. Australia indeed possesses all the concomitants of a highly organized political and social organism, and believes that it gets a full return for its public expenditure. The exceedingly close approximation of expenditure to revenue results from a disposition, whenever any considerable surplus appears in the accounts for any year, to devise further public conveniences which may be provided for the future, and so the surplus is absorbed. There is no general desire to show large surpluses nor is there much effort to reduce taxation, which is not felt to be burdensome, but rather to add to the facilities afforded for trade, and for the occupation and development of the country and of its industries. These ends are being achieved, and the cost of them is not grudged by those who have to find the money, and who reap the gain.

The debts of Australia have mostly been incurred by the states; until recently the Commonwealth carefully avoided any line of policy which would involve it in any necessity for embarking on a borrowing policy, on its own account. Indeed, as has already been suggested, the Commonwealth Parliament deter-

mined to construct all such public works as post-offices, fortifications, etc., out of revenue. It has taken over from the states all the customs houses, post-offices, naval and military defenses, stores, etc., which were the property of the states, prior to the establishment of the Commonwealth, and will ultimately have to recoup the states for them, either by taking over states' debts to an account equivalent to their value, or in some other way, which must almost of necessity involve the Commonwealth in a debt. There are further schemes in contemplation for the transfer of state obligations on certain terms to the Commonwealth, besides which there are proposals under consideration for the construction of trunk lines of railway across the continent of Australia; the line from South Australia to Western Australia has been approved and is in course of construction. All the states have some provision of the nature of a sinking fund for the ultimate extinction of the debts and in several cases stock is from time to time purchased and canceled out of funds set apart for purposes of redemption. None of these funds have, however, as yet assumed proportions sufficiently large to modify materially the facts as to the total debts. The debt of Australia up to 1915 in no case represented the cost of the war. The whole of it had been incurred with a view to the development of the vast resources of the continent and for practically the whole of it there are very valuable permanent assets. Of the total debt of the Australian states for 1914 £317,598,788 — £177,000,000 was spent on railways and tramways, on water supplies and sewerage, on harbors, rivers and navigation; and for public works and buildings about £75,000,000 has been spent, besides other sums for telegraphs, telephones, defense and other items. The net revenue produced by these works aggregated, in the year under review, over and above working expenses and maintenance, nearly 3 per cent on their cost. It should also be remarked that the year 1914 for which the figures are given was not a normal year, the effects of the previous year's drought having by no means passed away. The revenue from this source could be increased to an amount sufficient to meet in full the interest charge, if it were desired to do so, but the charges for railage and harbor dues and water supplies, etc., are all kept down with a view to the encouragement of settlement and of production, it being recognized that the direct return received from the enterprises is by no means the sum of their earnings, as they produce through the resulting prosperity of the people, a very large indirect return through the customs house, and in many other ways. It is the general prosperity rather than the direct revenue which is the primary objective for the time being. Meantime the works are permanent assets of constantly increasing value and revenue earning power. As has often been pointed out, Australia could, by sale of her railways, harbor works and water services, immensely reduce her public indebtedness, for the undertakings would sell readily for what they cost, but she would be poorer, rather than richer, by the transaction at once, to say nothing of the folly of such a policy from the point of view of the future. There is, further, one great asset of Australia which cannot be overlooked in any consideration of her financial position, and that is her unalienated land. In four out of the six states the areas are very large and the values vary very widely according to climate and other conditions.

It is necessary to bear in mind that the public indebtedness of the Australian states was not contracted against their specific security, but against the public credit of each generally, so that there is behind it, not only the public estate in the shape of the land and works of every kind, but also the whole taxing power of the respective governments. In view of this it must be manifest that the securities are absolutely "gilt edged."

The extent of the financial operations conducted within the Commonwealth will appear from the sworn returns of the banks other than the Commonwealth Bank, doing business there for the year 1914. The totals were: Notes in circulation not bearing interest, £306,809; bills in circulation not bearing interest, £1,089,548; deposits not bearing interest £70,195,462; deposits bearing interest, £93,659,093; balances due to other banks, £2,750,788; total liabilities, £168,001,700. The assets are shown as follows: Coin, £35,585,924; bullion, £1,024,100; landed property, £4,592,951; debts due to banks from other banks, including notes and bills discounted, £115,509,000; balances due from other banks, including notes and bills of other banks, £16,186,000; total assets, £175,449,306. Besides the joint-stock banks whose returns have just been quoted, there are numerous investment companies carrying on business in the Commonwealth, such as savings banks, land, building and investment, trading and commercial companies, complete returns of whose business are not available. For the savings banks, which are under government supervision, the following figures will be suggestive: Number of depositors, 2,108,000, or over 40 per cent of the whole population. Amount of deposit at close of 1914, over $400,000,000, or $80 per head of the whole population, and $200 per depositor. The volume of business done in the Commonwealth by the various life assurance offices is very large as the figures quoted below will show, and there are also a number of friendly benefit societies, whose roll of membership is indicative of the widespread practice of habits of thrift and self-help. Industrial life assurance is also widely availed of by persons who are not able to afford large premiums for life assurance of other types. The receipts and expenditure of the 17 life assurance institutions for the year were, receipts £6,000,000, expenditure £3,950,000. The average amount of life assurance per head of the population was £25. There are 477,000 members of the friendly societies, and their funds amount to £6,237,000.

Commonwealth Bank of Australia.— The Commonwealth Bank of Australia is the only state-owned bank in the British empire. It has had a most rapid growth and remarkable progress. The Commonwealth Bank Act was passed in 1911. On 15 July 1912 the act was brought into force by proclamation and savings bank business was commenced on that date. Every post-office throughout the whole of the Commonwealth of the rank of a money-order-office is an agency of the Savings Bank

Department of the Commonwealth of Australia, and at present there are 2,700 such agencies in addition to the six central offices, one in each of the state capitals.

General banking business was commenced in January 1913, and the expansion of business in the general as well as the Savings Bank Department has been phenomenal.

The outbreak of the European War in August 1914 found the Commonwealth Bank in a strong position, prepared to meet generally any emergencies which might arise, either in Australia or concerning Australian affairs in London, and an important part has been taken by the bank in the finance of Australia. Amongst the many matters of war finance which the bank has handled, the one which has brought it most before the public has been the Commonwealth war loans, the flotation of which was placed in the hands of the bank by the Federal Treasurer. Until the first Commonwealth war loan was issued in July 1915, no financial operations on a large scale had been carried out in Australia, and the issue of a loan for such a huge sum as £5,000,000 was, to a considerable extent, an experiment. Complete arrangements were made by the Commonwealth Bank with all the private banks, states savings banks and money-order offices throughout Australia to receive applications, and the loan was kept before the public in such an energetic manner that over £13,000,000 was subscribed in Australia. Since then two further loans have been issued. Each flotation has been carried out in the same energetic manner and the results of the three issues may be summarised as follows: First issue subscribers, 18,748; amount applied for, £13,389,440. Second issue subscribers, 28,945; amount applied for, £21,655,680. Third issue subscribers, 81,727; amount applied for, £22,276,200. The Commonwealth Bank acts as bankers in London to the governments of the Commonwealth of Australia, of South Australia, Tasmania, and mostly to the Western Australian government.

In October 1915 the bank floated successfully in London a loan of £2,000,000 for the South Australian Government, and toward the end of June 1916 the first issue of £4,000,000 was made by the Bank of London, on behalf of the government of the Commonwealth of Australia. In view of the fact that exchequer bonds, treasury bills, war certificates and French loans, all bearing interest at 5 per cent or over, were being offered by the Imperial and French governments at the same time, the launching of this loan was an event of considerable interest in the world of finance, and its success showed the confidence felt in the future of the Australian Commonwealth.

The Bank's Progress.— The progress of the bank may be demonstrated by the following figures. The deposits in the General Banking Department as well as the Savings Bank Department as under: June 1913, £5,055,381; June 1916, £41,732,116.

The figures of the profit and loss account are significant, it being borne in mind that the first half-year showed a debit balance of £46,636, owing to expenses of establishing and equipping branches throughout the Commonwealth. Since then the following profits have been made: December 1913, £1,547; June 1914, £8,093; December 1914, £13,428; June 1915, £25,788; December 1915, £50,949; June 1916, £93,898.

Savings Bank Department.— The comparative figures in this department indicate the steady increase in the support given in this institution — June 1913, depositors, 85,858; deposits, £2,694,774; June 1914, depositors, 143,786; deposits £4,645,268; June 1915, depositors, 210,361; deposits, £7,420,647; June 1916, depositors, 278,536; deposits, £9,477,895.

It will thus appear that as regards the public wealth, the private wealth and the annual product of labor and capital in Australia there are abundant evidences of soundness and of progress, and that Australia may fearlessly challenge comparison with any other part of the world. At the same time the magnitude of her undeveloped resources points unerringly to a future which shall outshine both the past and the present. Consult Carroll, 'The Agricultural Bank' (1914); McCarthy, 'Banking in Australia' (1912).

SIR F. W. HOLDER,
Speaker House of Representatives, Commonwealth Parliament 1901–09.

Hon. J. G. JENKINS,
Premier South Australia 1901–05, *Financial Advisor to South Australian Government* 1905–08, *Hon. Treasurer Imperial Council of Commerce.*

13. RAILWAYS AND TRANSPORTATION. The great problem which Australia has had to face in the development of her vast territory has been one of means of communication. Living on an island so large that it has been rated as an additional continent unlike any other in its makeup, a land of vast plains bounded and crossed at frequent intervals by stretches of hill country, devoid, for the most part, of extensive river systems, and beset by hostile native tribes, the people of Australia have been called upon to face conditions such as never confronted the upbuilders of any other continent. In both the Americas vast river systems have stretched forth the hands of the temptress to those adventurous and daring spirits for whom the unknown ever holds an attraction. Australia has had her explorers, but their pathway has been constantly beset by many and great difficulties. They have had to battle with heat, wind, apparently interminable stretches of sand and prevailing tropical diseases, all forming a foreground to the constant hostility of the natives and working in conjunction with a still more terrible enemy, thirst. These same enemies have continued to oppose every step taken in the direction of the establishment of ways of communication by the government of the various states of Australia, upon whom has fallen, for the most part, a task which, in most other countries of recent development, has been undertaken and carried through by private enterprise. Naturally, therefore, Australia's communication has been largely by way of the sea and this, in turn, has developed her coast lands at the expense of her vast interior regions, most of which still remain partially or altogether unsettled and unspanned by railways and other highways, byways or trails. Most of the 22,000 miles of railways of government and private ownership of Australia are situated in the south, southeast and southwest, in the states

of New South Wales, Victoria, Western Australia and Queensland. A line planned to cross the centre of the island from north to south is partially constructed, most of the finished part being in the south, though the Federal government has lately completed 200 miles of track from Port Darwin to Catherine in Northern Territory. The present plan is to continue this latter road through Queensland to make connection with the state road running out of Brisbane westward, and to extend another branch southward to Oodnadatta, the northern end of the state railway system of South Australia. But all this railway construction, encouraging though it may be, is but a comparatively small part of the railway facilities demanded by Australia's vast territorial expanse. When the comparatively level nature of her territory is taken into consideration, Australia has made less progress in railway construction than many other countries with fewer facilities and needs for ways of communication. This is due to the fact that railway construction on the island continent has been almost altogether in the hands of the various states of the Commonwealth, who early developed rival interests which reached a point where the welfare of the country as a whole was forgotten in the antagonism of state against state. In the early days of Australia's development, the various states were so effectually separated from one another that they formed, for all practical purposes, separate political entities; and even when the Federal government began to exert itself for greater Federal unity and the subjection of state interests to those of the island as a whole, the states continued to develop a policy of commercial rivalry which strongly approached antagonism and formed a barrier to the political unity of the Commonwealth. This policy of localism runs throughout the history of the railroad promotion and construction of Australia. Owing to this political isolation of the states of the Union, and the consequent weakness of the Federal government and its comparative poverty, practically all the railway construction undertaken in Australia for public uses has been done by the various states. As the states voted the money for the building and maintenance of all new railways, this part of the nation's development became strongly subject to local politics. Each member of the local legislature, in conjunction with the local politicians, found it to his interest to secure railway concessions for his own particular district; and the local districts objected strongly to voting money for the extension of railways into other districts where the population was nil or too sparse to force the attention of the state legislature. The result was that scores of comparatively short lines were built at the state's charge as feeding lines to the more populous centres. Most of these ended, as a noted Australian writer has said, "nowhere." This policy, or want of policy, was bad enough, but the commercial rivalry and jealousy of the various states forming the Commonwealth intensified the situation by ceaseless and tireless efforts to divert trade from its natural channels in what were considered state interests, rights and necessities. Thus even after railway lines had been extended practically across state, they were not allowed to be continued to the border of the neighboring state lest the government of that state should make railway connection therewith and thus be in a position to divert trade to its own capital, seaport or other important commercial centre. The railways of the various states established cut rates lower and more demoralizing than were probably ever put into effect in any other country. By this means the trade of interior towns and districts was diverted from its natural market often less than a score of miles away, and carried across state by rail to the state capital or seaport. In support of this restrictive policy, Australia, with scores of the finest natural ports in the world, remained with her waterfront comparatively undeveloped, because each state seemed to think that trade could be better controlled for local interests by having it go through one great port. So strong was this feeling of localism that even the state ports were, to a certain extent, jealous of commercial rivals; and thus, when one port succeeded in getting the lead of all the others in the state, it was able to maintain this lead through its political and commercial importance.

Though the Federal government is empowered to construct railways for the Commonwealth, it can do so only after receiving the consent of each state through which the railway line has to pass, and the localism and jealousy of the states have in many cases prevented the construction of Federal railway lines. South Australia held up, for a considerable time, in order to secure special state concessions, the projected Federal railway laid out across the centre of the island from east to west; and other Federal railway projects have met similar difficulties. The plan to unify the railway system of Australia met for years with strong opposition from local state interests. The result of this short-sighted policy is that not only have state interests suffered, but the development of vast fertile regions of the interior has been retarded and their settlement discouraged to such an extent that the more populous centres of the island went so far as to persistently misrepresent the conditions for agricultural development obtaining in interior districts. Through these misrepresentations the outside world was long led to look upon Australia as a land of great deserts bordered by a fertile belt running round the coast of the island. This misrepresentation gave the death blow temporarily to the upbuilding of a great railway system which would undoubtedly have opened up and developed the rich interior districts of the island and solved the question of attracting immigrants. Owing to the early developed and long continued intense localism, Australia has become an ardent advocate of state-owned railways; but as the railways were, for the most part, under the control of the states, whose local antagonism was well known, it became very difficult for these local entities to secure foreign capital for the building of roads which, in many cases "began nowhere and ended nowhere." The states were generally disinclined to take risks by extending existing railways or building new ones into sparsely settled or unpopulated districts; and they were equally unwilling to encourage or even allow exploiting companies to take risks in railway extension where they declined to do so themselves; and even to

the few companies to whom concessions were granted, for special local or industrial reasons, to construct private railways, they refused to grant concessions of vacant lands. Thus one of the greatest incentives of modern times to the development of unpopulated districts has been legislated out of existence in Australia.

The control of harbors, rivers, telegraphs and telephones came naturally under the government of the individual states. The inconvenience of this condition of affairs was early seen and the six distinct state postal and telegraph departments were taken over by the Federal executive in 1901 and amalgamated, and the administration placed in the hands of a Postmaster-General; a cabinet minister and a secretary for each state acting under the Postmaster-General. But notwithstanding the fact that the Federal legislature was thus put in control of the postal and telegraph business of the Commonwealth the localism of the states made it necessary to retain, for a time, existing postal rates, which the states were unwilling to give up. The Postal and Telegraph Rates Act of 1 Nov. 1902 provided for uniform charges in all states for the conveyance by post of newspapers and the transmission of telegrams, but it was not until 1910 that uniform postage rates became part of the law of the Commonwealth under the Postal Rates Act which became effective 1 May 1911. The passage of this act and the good results to local and Federal business interests which resulted therefrom did probably more than any one other factor to uniform the sentiment throughout Australia in favor of a united railway policy. This unity of sentiment was heightened by Australia's very active participation in the European War which gave the Federal executive an influence over the states of the Commonwealth which it had never before possessed, and tended very strongly to increase the feeling of nationality throughout the land and the subjection of local interests to the welfare of the island as a whole. Burning questions which have long stirred up state rivalries, such as riparian rights, seem in a fair way to be settled amicably in the interest of the common weal. This latter question, at one time, seriously threatened to affect transportation of river, railway and port. South Australia greatly feared that the deflection of the waters of the rivers Darling and Murray by riparian landowners for irrigation and other purposes would so lower the water in these rivers as to kill the river trade to the railways and the coast from the towns along the banks within state territory. This bitterness of feeling over state water rights exerted a very strong influence upon the railway policies of the four interested states, South Australia, on the one hand, and New South Wales, Victoria and, incidentally, Queensland, on the other, by accentuating their desire to each thwart the commercial schemes of its rival states by preventing their making use of the railways within its own boundaries under conditions favorable to their commercial ambitions. According to Federal law preferential rates in the various states had to be approved by an interstate commission; but the states easily found a way to avoid the provisions of this law, which was somewhat weak-kneed in its provisions and still more so in its enforcement. Lately, however, sentiment has turned strongly in favor of the enforcement of this and other laws for the development of the interests of the Commonwealth and the upbuilding of a truly national spirit in commercial as well as in other respects.

The first short railway was opened in Australia in 1855, but building did not become active until 1875, and then only in sections of the southeast of the island. In 1855 Australia possessed 23 lines of railway; in 1861, 243; in 1871, 1,042; in 1881, 4,192; in 1891, 10,123; in 1901, 13,551; in 1910, 17,421; in 1912, 18,677. The mileage of railways increased more slowly in Australia during war years than in normal times preceding the outbreak of the European strife. During the fiscal year ending 30 June 1916, the government lines open for traffic were increased by 676 miles, while private lines actually decreased 33 miles. During the previous year the increase in the mileage of the government lines was 1,735 miles and that of the private lines 146 miles. At the close of the fiscal year ending 30 June 1915, the railway mileage of the several states was as follows: New South Wales, 4,134; Victoria, 3,848; Queensland, 4,839; South Australia, 2,168; North Territory, 145; Western Australia, 3,332; and Tasmania, 533 miles. The cost of construction of these various state lines was in round numbers: New South Wales, $267,500,000; Victoria, $229,000,000; Queensland, $138,500,000; South Australia, $5,000,000; Western Australia, $66,000,000; Tasmania, $21,000,000. At the close of the fiscal year ending 30 June 1917, Australia possessed about 22,000 miles of government and privately owned railways.

The highest earnings of the government roads were during the fiscal year 1913–14, when they reached $33,640,920. The highest earnings of the several states were as follows: New South Wales (1915–16), $11,296,700; South Australia (1912–13), $3,960,900; Tasmania (1912–13), $534,600; Queensland (1914–15), $6,936,800.

Australia has at last awakened to the necessity of interstate railway and other means of communication, and Sydney, Melbourne and Adelaide are now connected by a main interstate line 1,790 miles in length and, in Western Australia, a system of trunk lines is in a fair way to connect the state ports with most of the important agricultural, pastoral and mining districts by means of an extensive system of branch lines. The latest movement to unify the transportation facilities of the southern half of the Australian continent from east to west coasts has resulted in the connecting of the various state lines and the construction of a Federal government trunk line known as the Transcontinental or Port Augusta-Kalgoorlie Railway linking the eastern and southern roads with the western, by means of a line 1,052 miles in length skirting the Great Australian Bight. By means of this line the state roads of Western Australia, Victoria, New South Wales and Queensland have been linked together so as to constitute a means of traffic across Australia from the Indian to the Pacific oceans. This line, or union of lines, is a curious combination which well illustrates the difficulties to be overcome in the upbuilding

of a truly national system of railways in Australia. Over 2,000 miles constituting the part from Brisbane to Port Augusta, by way of Sydney, Melbourne and Adelaide, is composed of various state lines. The next link in the chain, from Port Augusta to Kalgoorlie, over 1,000 miles, is a Federal line, while the remaining part, from Kalgoorlie to Perth, 370 miles, is under state control. The Federal part of this transcontinental line was begun at Port Augusta in September 1912 and finished five years later. The estimated cost to the Commonwealth was originally $20,228,230; but before the road was completed there had been expended upon it about $34,000,000. This increased cost was due largely to the increase in the value of materials of all kinds, the advance in wages and the alteration in the original plans for the betterment of the road in general.

In Tasmania the principal towns are connected by a system of lines with branches reaching out to the mining districts, more especially in the west of the island.

Of the 1,755 miles of privately owned railway lines in the Commonwealth on 30 June 1915, only 944 were available for general traffic, to a greater or less extent, while 811 miles were used for special purposes.

Australia is subject to a great yearly rush of business when wool, live sheep and mutton are hurried to port. The one-door policy of each state invited congestion of traffic. This congestion was increased by the want of system in the construction of the railways of the country which prevented the use of the rolling stock to anything like its full capacity; for the east was cut off from the west and, as we have seen, one state from another. Another great difficulty, which still exists, was the many railway gauges in use throughout the Commonwealth. In New South Wales practically all the railway is standard gauge; in Victoria most of the track is 5 feet 3 inches; in Queensland and South Australia and Western Australia it is 3 feet 6 inches. These various gauges have formed one of the greatest stumbling blocks in the way of the unification of the railway system of the Commonwealth and a strong barrier to cheap interstate traffic. In 1912 there were in Australia 4,222 miles of 5 feet 2 inches gauge; 4,013 of 4 feet 8½ inches; 10,099 of 3 feet 6 inches; 122 of 2 feet 6 inches; 221 of 2 feet; and 18 of 1 foot 8 inches. The natural result of these railway conditions is that everywhere in Australia, except where preferential rates are made to promote local aims, freight rates are high, often running from 6 to 10 times what they are for similar distances in the United States. A considerable part of these high rates is to be charged up to frequent handling and transshipment of goods *en route* between points in different states, and even between different points within the same state when roads of different gauges have to be used for the same shipment. Freight rates have improved lately owing to the opening of interstate communication in the south and east; but there is urgent call for a still greater improvement.

In the various states of the Commonwealth the railways are grouped for convenience of administration and management into the following divisions or systems: New South Wales, Northern, North Coast, Western, Southern, South Coast and Suburban lines; Victoria, Southeastern, Eastern, Northeastern, Western and Southeastern, and Suburban; Queensland, Southern, Central and Northern divisions; South Australia, Midland, Northern, Southern, Southeastern, Port Broughton and Western systems; Western Australia, Eastern, East Goldfields, Southwestern, Great Southern, Northern, Hopetoun-Rovensthorp railways. Tasmania's railway system is arranged in 12 divisions following the names of the railways, each of which is under a separate management. For the administration of its railways each state has its own laws, customs and regulations. The Federal government has also railway lines in South Australia and in the Northern Territory. In New South Wales the management of the state railways is in the hands of a chief commissioner, who has an official commissioner for railways and another for tramways; Victoria has three railway commissioners; Queensland, South Australia, Western Australia and Tasmania one commissioner each; while the railways of the Northern Territory are administered by the government of the Commonwealth. The private roads which, naturally, are administered by their owners, are engaged for the most part, in the carrying of coal, ores, stone, sand, gravel, firewood timber, sugar, farm produce and occasionally passengers.

Shipping and Navigation.— Regular steamship communication between Australia and Europe was established in 1852 by the Peninsular and Oriental Company by way of Singapore to Sydney via Adelaide and Melbourne. Owing to the Crimean War this service was suspended in 1854, to be resumed two years later by the same company in conjunction with the Royal Mail Company. In 1869 the Union Pacific Steamship Company and the Pacific Steamship Company opened a line of communication between Sydney and San Francisco via Auckland. For this service a subvention of £37,000 per annum was paid by the state governments of New South Wales and New Zealand. About this time subsidized French and German mail service was established and later lines were put into commission via Vancouver and via the Suez Canal. Canada, Australia and Great Britain entered into an agreement for an inter-British line and great increase in speed and efficiency was the result of this agreement, not only via Canada but, as a natural result, via San Francisco. This again acted on the home ports which were forced to increase their facilities for communication with one another. Numerous other steamship lines, local and inter-continental, have since been established, so that Australia is now well connected by water with all the great maritime countries of the globe.

Submarine Cables.—The question of the connection of Australia by cable with Europe was brought up in Great Britain and Australia in 1853, but it was not until 1871 that the dream was realized and London was connected by wire with Port Darwin, and the following year, via this latter port, with Adelaide at a cost of £500,000. Tasmania had already been connected with the mainland in 1869. In 1909 two cables were laid to connect Tasmania with Victoria (390 miles). In 1901 a direct cable was laid to Great Britain via the Cape of Good

Hope and another across the Pacific, the following year, from Adelaide to Canada, thus linking up the chief British possessions and touching only British territory. As early as 1876 New Zealand had already been joined with Australia by cable covering 1,191 miles. Numerous other cables have been constructed to connect the island with outside points or the various seaport cities of Australia with one another. These cables are connected with a very extensive telegraph system traversing the island from north to south and from east to west and reaching out to practically all the cities, towns and villages of the island. Wireless telegraph stations are in operation in all the state capitals and larger cities of the Commonwealth.

Postal Rates.— According to the Postal Rates Act of 1910 the rate on letters, letter cards and post cards anywhere within the Commonwealth is 2 cents per ½ ounce; printed papers 1 cent per 2 ounces; domestic books and magazines 1 cent per 8 ounces; foreign books and magazines 1 cent per 4 ounces; commercial papers, patterns, samples and merchandise 2 cents per 2 ounces; newspapers issued from the office of the publisher or vender or returned by the agent or dealer 2 cents per 20 ounces; all other newspapers 1 cent each for weight of 10 ounces or under. Ordinary letters of a private or semi-private nature are 5 cents per half ounce for countries outside the British empire and 2 cents per half ounce for countries within the empire.

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14. THE LABOR PARTY. The Australian Labor party has its genesis in the great maritime strike of 1890. It is true that spasmodic attempts had been made during earlier years to procure direct parliamentary representation for working-class interests, and in two or three isolated instances men had been returned to one or other of the colonial Parliaments. Nothing, however, in the nature of an extended or sustained effort had been attempted prior to the great strike. For some years before 1890 the trades unions generally had been gaining in strength and influence and had won many concessions from the employers in regard to wages and working conditions; but the seafaring classes had not participated in these advantages in anything like equal degree. A crisis was reached when the marine officers, who had been for years overworked and underpaid, decided to form a union and affiliate with the other labor organizations. The shipowners demanded, as a preliminary to the discussion of grievances, that the officers should dissociate themselves from the labor unions; but fearing this would leave them at the mercy of the employers, the officers refused to acquiesce, and a strike was precipitated. In sympathy with the officers, the seamen and longshoremen around the coast ceased work and as the employers continued obdurate the trouble extended until the strike included many unions wholly unconnected with shipping. "Freedom of Contract"— an equivalent of the American "open shop"— became the war-cry of the employers, and practically the whole community took sides with one party or the other. After a struggle lasting some three months, during which trade was paralyzed, much bad blood created and both sides financially injured, the men acknowledged defeat. Apart from the cost to the combatants themselves the public had suffered severely, and when the smoke of battle had cleared away there was a general desire expressed to find some way of avoiding similar conflicts in the future. A royal commission was appointed by the government of New South Wales, and served some good purpose in ascertaining clearly the grievances of the men; but it achieved little of a practical nature beyond suggesting the creation of an arbitration court to which disputes could be voluntarily referred. The press, while mostly taking the employers' view upon the points at issue, concurred in advising the unions to rely upon legislation to remedy their legitimate grievances, and this advice was taken seriously by the men when they emerged from the conflict — defeated, but grimly determined to retrieve their lost influence.

While the effects of the strike had been felt all through Australia, the battle had raged most fiercely along the eastern seaboard, where population is greatest, and therefore the colonies mostly affected were those of New South Wales, Victoria, Queensland and South Australia. It was in these colonies, then, where the cry arose for a more equitable distribution of political power and a greater consideration of labor interests. This demand was accentuated by the political conditions existing at the time. From the granting of self-government the Parliaments of the various colonies had included many men who fought strenuously for the people's interests, and who deserve the whole-hearted gratitude of the reformers of to-day; but in spite of their efforts matters political were so backward in 1890 that there was an urgent need of a fresh impulse. While manhood suffrage had been nominally secured, plural voting obtained in all the colonies except South Australia; factory legislation was either non-existent or so inefficient as to be practically useless; except in Victoria, nothing had been done to protect those working in dangerous occupations, such as mining; the question of employers' liability was in a very unsatisfactory state; hours of employment were unregulated, and sweating was rampant; and many other social questions were carefully avoided. In addition, and perhaps most important, there was no method by which public opinion could find expression in an authoritative manner with regard to the merits of labor disputes. Briefly, the complaint of the unionists and their sympathizers was that working-class interests had been neglected, as should perhaps have been expected from Parliaments made up for the most part of the wealthier classes or their representatives.

With a view to altering this state of affairs for the better, the unions decided upon political organization; but, recognizing that no purely class effort could be permanently successful, they called upon radicals generally to assist them in the work of reform. On this wider basis leagues connected with, but independent of, the unions were formed, and programs embracing the legislation immediately desired were speedily adopted. Necessarily these dif-

fered with the circumstances existing in the various colonies, but in the main they were markedly similar. In all, the central idea was to form a new party, working independently of those already existing, and prepared, until strong enough to take office, to accept instalments from either of the older parties. Taking the platform adopted in New South Wales as typical, the aims of the new party were stated as being: "(1) To secure for the wealth-producers of this colony such legislation as will advance their interests, by the return to Parliament of candidates pledged to uphold the platform of this league: (2) to secure the due enrolment of all members of the league who may be entitled to a vote in any electorate: (3) to bring all electors who are in favor of democratic and progressive legislation under one common banner, and to organize thoroughly such voters with a view to concerted and effective action at all Parliamentary elections in the future."

The platform adopted ran as follows:

1. Electoral reform — to provide for the abolition of plural voting; the abolition of money deposits in Parliamentary elections; the extension of the franchise to seamen, shearers, and general laborers by the registration of votes; the extension of the franchise to policemen and soldiers; the abolition of the six months' residence clause as a qualification for the exercise of the franchise; the establishment of single member electorates and equal electoral districts on an adult population basis; the holding of all Parliamentary elections on one day — that a public holiday; and that all public houses shall be closed during the hours of polling.
2. Free, compulsory, and technical education — higher as well as elementary — to be extended to all.
3. Eight hours to be the legal maximum working day in all occupations.
4. A Workshops and Factories Act to provide for the prohibition of the sweating system; the supervision of land, boilers, and machinery; and the appointment of representative working men as inspectors.
5. An amendment of the Mining Act — to provide for all applications for mineral leases being summarily dealt with by the local wardens; the strict enforcement of labor conditions on such leases; the abolition of the leasing system on all new gold fields; the right to mine on private property; the greater protection of persons engaged in the mining industry; and that all inspectors shall hold certificates of competency.
6. The extension to seamen of the benefits of the Employers' Liability Act.
7. The repeal of the Masters and Servants Act and the Agreements Validating Act.
8. The amendment of the Master and Apprentices Act and the Trades Union Act.
9. The establishment of a Department of Labor; a National Bank; and a national system of water conservation and irrigation.
10. Election of magistrates.
11. Local government and decentralization; the extension of principle of the Government acting as an employer, through the medium of local self-governing bodies; and the abolition of our present unjust method of raising municipal revenue by the taxation of improvements effected by labor.
12. The federation of the Australian colonies on a national as opposed to an imperial basis; the abolition of the present Defence Force, and the establishment of our military system upon a purely voluntary basis.
13. The recognition in our legislative enactments of the natural and inalienable rights of the whole community to the land — upon which all must live and from which by labor all wealth is produced — by the taxation of that value which accrues to land from the presence and needs of the community, irrespective of improvements effected by human exertion; and the absolute and indefeasible right of property on the part of all Crown tenants in improvements effected on their holdings.
14. The execution of all Government contracts in the colony.
15. The stamping of all Chinese-made furniture.
16. Any measure which will secure to the wage-earner a fair and equitable return for his or her labor.

On these lines the Labor party entered the political arena in the four eastern colonies. The first skirmish occurred in South Australia, when the new party succeeded in returning three workingmen to the Legislative Council (the Second Chamber) in spite of a restricted franchise. This happened early in 1891, and in the middle of that year the first real trial of strength for control of the popular chamber took place. This was in New South Wales where, notwithstanding the existence of plural voting, the Laborites captured some 36 seats out of 141. In 1892, Victoria followed the example of the older colony by returning a small contingent of Labor members, and in 1893, both Queensland and South Australia elected parties of greater proportionate strength on the Labor ticket.

With the first Labor successes the wildest views were expressed by critics on both sides— the Conservatives prophesying utter ruin for the community, and many Labor supporters expecting that the millenium would arrive in short order. Needless to say, both proved wrong. In the first place it was soon found that a proportion of those returned as Laborites were so only in name, and had no conception of the sentiment responsible for the movement. These quickly dropped out or were pushed aside. Then, as might have been expected in a party hurriedly organized, there arose internal dissensions of such a character as to seriously threaten, in one or two of the colonies, the future of the movement. As matters settled down, however, the need for cohesion was emphasized and with the recognition of that fact better work resulted. Looked at broadly, the first Labor contingents did excellent work, which served to encourage the party's supporters to renewed efforts, and as a result the parties in the various colonies have been increasingly strengthened at each successive election. This steady growth has not been confined to those colonies where political organization was first entered upon, but has extended also to West Australia and Tasmania. At the present time (1916) Labor Premiers are at the head of governments in New South Wales, Queensland and South Australia, while in Victoria and West Australia the Labor parties constitute the direct opposition, with the reversion of office. Until an election in 1916 the Labor party had been in power for some time in Tasmania and in Western Australia.

The Labor party has, during its 25 years of existence, succeeded in gaining a majority in the Australian Parliaments with the exception of Victoria. Its influence is not to be gauged solely by its numerical strength. In most of the colonies its appearance galvanized the older parties into some appreciation of the need for social legislation. Old-time politicians suddenly manifested a tender regard for the interests of the working classes, and vied with each other in propounding schemes for the amelioration of their condition. The democratization of those outside its ranks is among the most noticeable gains of the Labor party, and has resulted in many useful reforms being brought about.

In New South Wales there has thus been secured during the party's existence and since their assumption of office a liberal Electoral Act, abolishing plural voting; an act to allow mining on private property; land and income

taxes, adjusting taxation more equitably; a Coal Mines Regulation Act; a Workshops and Factories Act; an Amending Land Act to permit of perpetual leasing in lieu of outright sale; an act to restrict the admission of colored immigrants; an important Navigation Act; an Early Closing Act, applying to shops; an Old Age Pensions Act; an act to nationalize the private wharves of Sydney; the Miners' Accident Relief Act, designed for the relief and maintenance of injured miners and their dependents; the much-discussed Industrial Arbitration Act, prohibiting strikes and insisting upon the reference of disputes to the decision of a judicial body, the Women's Franchise Act and several other acts in connection with industrial matters.

In South Australia education has been made free; the state has established a successful Produce Export Department; the nucleus of a state bank has been formed, providing cheap loans to settlers; workmen have been assisted to take up land; adult suffrage has been passed; factory legislation and early closing of shops secured; wages have been protected against liens; private estates have been resumed and cut up for settlement, and other practical measures made law.

In Victoria the party's influence has secured, among other things, improved factory legislation, providing for boards to fix minimum wages; compulsory early closing of shops; abolition of plural voting; resumption of land for closer settlement, and cheap money for farmers on the *credit foncier* system; minimum wage on government contracts; state supervision of dairies; prohibition of secret trade commissions; pure food laws; exemption of tools of trade and furniture to the value of £20 from distraint for rent.

In Queensland legislation has been passed providing for the early closing of shops; adult suffrage and equal voting power; workers' compensation; state supervision of exports; cheap advances to settlers, and the readjustment of taxation in favor of the poorer classes.

In West Australia the record includes adult suffrage, with electorates, approaching equality; factory laws and early closing of shops; compulsory arbitration in industrial disputes; prohibition of secret commissions in trade, and minimum wages on government contracts.

With the inauguration of Federation in 1901 a new phase was entered upon as a number of the most important governmental functions were transferred from state to Federal control; and the Labor political organization throughout Australia agreed to a common platform upon which to contest the first Commonwealth elections. It ran as follows:

1. Electoral Law, providing for one adult one vote.
2. Total exclusion of colored and other undesirable races.
3. Old-Age Pensions.
4. The Constitution to be amended to provide for: (a) The Initiative and Referendum for the alteration of the Constitution; (b) the substitution of the National Referendum for the double dissolution in the settlement of deadlocks between the two Houses.

At the first Federal elections, held in 1901, the Labor party returned eight members out of 36 in the Senate and 16 out of 75 in the House of Representatives. Three years later, at the elections of 1903, the numbers were increased to 14 in the Senate and 22 in the House of Representatives. Since then the number in both Houses has so increased that a large majority of the members are Labor representatives. In the 1st Parliament it found a fairly progressive government in office, with a program including several planks of the Labor platform, and some of these found expression in legislation. Naturally much time was occupied in passing necessary machinery measures, and the tariff discussion alone took up nearly 18 months. But time was found to pass adult suffrage and a liberal electoral law. The restriction, amounting practically to exclusion, of colored immigration was secured, and provision made for the cessation of the traffic in Kanaka labor. In the Public Service Act a clause was inserted providing for a minimum wage of £110 yearly for adults of three years' service. When the tariff was being considered, the Labor party, though assuming no party attitude on protection or free trade, led the way in abolishing or reducing revenue taxes through the customs, and later it headed a successful resistance to the proposal to enter upon a borrowing policy.

At the second general election the Labor party increased its strength at the expense of both the Protectionists and Free Traders, with the result that when the Parliament met it contained three parties nearly equal in numbers. The Protectionist government resigned through suffering defeat on an important phase of the Industrial Arbitration Bill, and a Labor government took office. After a few months it was also defeated on one of the principles of the same measure, and was succeeded by a coalition ministry representing Free Traders and Protectionists. This government passed the Arbitration Bill through its remaining stages, but on again meeting Parliament was in turn defeated by a combination of Protectionists with the Labor party. Since then measures have been passed to prohibit false trade descriptions; to render illegal the acceptance of secret trade commissions; to allow of the protection of union trade-marks in common with those of the trading community; and dealing with other matters of importance.

In touching thus sketchily upon the work of the various Parliaments of Australia since the Labor party has arisen, the writer attempts to do no more than indicate the trend of legislation as affecting the working classes and bearing upon social problems generally. In both the state and Federal Parliaments, during the time covered, many other important laws have been passed, and in regard to these the Laborites have borne their share of the work involved. It is, however, to the Labor party that credit is mainly due for the quickening of the public conscience which has resulted in so many ameliorative measures being passed in a comparatively short period.

The Labor party has been accused of concerning itself only with the interests of the working classes; but gradually it is being recognized that the term "Labor" includes brain as well as hand workers, and all sympathizers are welcomed as members of the political organizations. The Labor parties in Parliament include a fair sprinkling of professional and business men, who in any narrow interpretation would be excluded. There is no doubt that much of the success so far achieved is due to the recognition of the fact that the interests of all producers are identical and that justice must be extended to all equally.

Much has been said about the socialism of

the Australian Labor party, and it is alluded to by some as a recent development. That is not so, as there has been no change, except perhaps in form, in the aims and program as first put forward. Leaving aside the fact that nearly every plank of the original platform was broadly socialistic in its interference with individualism, distinct aspirations toward collectivism were voiced in the first declarations of the party. In Queensland this took the most pronounced form, where as early as 1890 the council of the Australian Labor Federation, having decided upon political action, put forward as its aim "The nationalization of all sources of wealth and all means of producing and exchanging wealth." This was a declaration for complete socialism, but the organizations in the other colonies refused to go that distance. The New South Wales League in 1890 adopted a proposal for "the extension of the principle of the government acting as an employer, through the medium of 'local self-governing bodies,'" and thus committed itself to socialistic ideals. In some of the other colonies declarations of principle were considered unnecessary, and the platforms contained no direct mention of socialism, though many of the detailed proposals were of a socialistic character. Later on, the Queensland organization dropped for a time any direct reference to socialism, but continued its propaganda on collective lines. In 1897 New South Wales adopted as a plank of its platform "the nationalization of the means of production, distribution and exchange," and that remained on the program until 1905, when it was struck out. At the same conference a statement of the local party's objective was agreed to, which has since been adopted by an Australian conference as the objective of the Federal Labor party, and may be here quoted: "(1) The cultivation of an Australian sentiment, based upon the maintenance of racial purity and the development in Australia of an enlightened and self-reliant community. (2) The securing of the full results of their industry to all producers by the collective ownership of monopolies and the extension of the industrial and economic functions of the state and municipality."

The dropping of the "whole hog" plank in favor of this statement of aims was looked upon as a retrograde step by the more ardent socialists in the movement; but it appears to have been dictated by common sense. The platform is theoretically a program for realization when the party gets a majority, and it is clearly impracticable to attempt to carry out any complete scheme of socialism to-day. Recognizing this, the party declares its belief in socialistic principles, and adjusts its program so that every step taken will be in consonance with that ideal. This is shown in the platform for the Federal elections at the end of 1906, which was as follows:

1. Maintenance of a white Australia.
2. Nationalization of monopolies.
3. Old-age pensions.
4. Tariff referendum.
5. Progressive tax on unimproved land values.
6. Restriction of public borrowing.
7. Navigation laws (provision for manning, etc.)
8. Citizen defense force.
9. Arbitration act amendment (ensuring effectiveness).
10. Commonwealth bank of deposit and issue and life and fire insurance department.
11. Uniform industrial legislation; amendment of constitution to provide for same.
12. Civil equality of men and women.

Since this platform was put forward, "White Australia" has been maintained, "Old Age Pensions" have been adopted, a "Progressive Land Tax" has been passed, "Navigation Laws" and laws to provide for "Citizen Defense Forces" have also been passed. Amendments to the "Arbitration Acts," "Uniform Industrial Legislation" and a "Commonwealth Bank of Deposit and Issue" (see FINANCE) have also been enacted.

This platform insists that monopolies shall be nationalized, as constituting a public danger, and the Labor party expresses its disbelief in the efficacy of measures designed to merely regulate modern trusts. Under its objective the party will embrace every opportunity of extending the functions of collective authority where it is shown to be practicable and of value to the community. From this statement of the position it will be seen that the Labor party is undoubtedly socialistic, but it does not propose to plunge Australia suddenly into any experiment of a wholesale character. The people have control in respect of each successive step, and may be relied upon to call a halt if at any stage failure is experienced.

Two proposed laws for the alteration of the constitutional powers of the Commonwealth in regard to industries and business were submitted to the people by referendum for acceptance or rejection in April 1911. The first proposal was to amend the Constitution Act so as to give the Commonwealth government increased powers to deal with trade and commerce, corporations, industrial matters and trusts and monopolies. The second proposal was to empower the Commonwealth government to make laws with respect to monopolies; both of these proposals were rejected by popular vote. They were again submitted to the vote at the general elections in May 1913, and again rejected.

On the whole, the Labor party throughout Australia has given a much needed impetus to social legislation; and, in reply to those who urge that its objects and methods are opposed to the welfare of the community, it points to the fact that since its appearance in Australian politics wealth has found a wider distribution; hours have been shortened and wages raised in many occupations; sweating has been minimized; and that, though much remains to be done, the people enjoy greater prosperity than before the advent of the new political force.

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J. C. WATSON,
Premier of Australia, 1904.

15. SOCIAL CONDITIONS. The social conditions of a country may be considered from different points of view. They might be considered from the general welfare of the people, or from what is known as social distinction in society. This last aspect of the question could be disposed of in a few words so far as Australia is concerned. The people mostly belong to the great class of honest industry in one form or another. The large majority are, if necessity requires, willing to undertake al-

most any kind of work, while those who are wealthy, with but few exceptions, prefer useful or philanthropic employment to a life of idle dissipation.

The common weal of the people is indicated by the fact that in no country is there less real poverty than in Australia, or better and more systematic organization for dealing with those few persons who are in need of temporary assistance. No one is ever knowingly allowed to suffer for want of food. The state does not consider it to be its duty to find employment for those who may be out of work, but in the interest of humanity it always provides food for those in want of it.

It has been said that the happiest people are those who can live upon the products of their own country. Australia offers greater possibilities for such happiness than almost any other land. Cattle and sheep, pigs and poultry, all kinds of grain, vegetables of every variety, and nearly all known fruits are easily produced by properly applied industry.

Primary Productions.—Lord Sydenham, G.C.M.G., who was governor of Victoria for some years, after his return from Australia said "It may be taken as certain that where the averages from primary production stand high the country is a good one." This dictum has such a direct bearing upon the condition of the people that the comparisons become important. According to population the primary production in Australia is greater than in Canada, 50 per cent greater than in the United States, twice as great as in France, three times as great as in England and over four times as great as in Russia.

The productive nature of the soil and climate has a great deal to do with the fact that a greater number of people in Australia, in proportion to its population, enjoy more of the comforts and pleasures of life than is the case in many other parts of the world. The people as a whole are better housed, fed and clothed than the residents of most other countries. Cheap houses and discomforts are to be found in Australia as elsewhere, but even in the cities there is a lack of the poor shanties and tenements which are so noticeable in many large cities in Europe, Asia and America.

Educational Advantages.—No one question has a more important or direct bearing upon the social conditions of the people than that of education. No country has better facilities, and but few as good, and with the exception of some parts of America, Australia affords as good an opportunity for secondary and advanced education at a moderate cost as any other country.

Generally speaking, the system of public education is free, compulsory and secular, the whole expense being met out of the general revenue. The greatest care is taken to provide schools in every part of the country as well as in the thickly populated cities, and in some of the thinly settled districts, schools of from 10 to 15 children are established. Fortunately, Australia's educational advancement has not been delayed by sectarian interference. There it is generally considered that a country's advancement rests on the education of its people, and that as national education is a national gain, the nation's treasury should meet the bill. Efforts have been made from time to time by zealous propounders of sectarian beliefs to incorporate religious instruction with the Education Acts of the different states, but the majority of the people are strongly opposed to any form of state aid to religion. They feel that in the bitter strife for sectarian supremacy the efficiency of the schools would become impaired and the practical education of the children neglected. A large majority of parents take advantage of the public schools for their children, but for those who object, either from class prejudice or religious scruples, good private schools are available.

The technical schools, colleges and universities afford ample facilities for higher education. The Australian universities stand high in the educational world. By bequests, endowments and grants of land they have been enabled to provide splendid buildings and appliances, and to procure able and learned professors. The degrees conferred are recognized and respected in other lands. No one need leave Australia to become well versed in music, medicine, literature, law or science. The technical schools have been especially valuable from a mining point of view, and many of those who have received their instruction there are now holding important positions on mining fields in Australia and other countries. Nearly 1,300 public libraries with 2,000,000 volumes of valuable literature are a great help to those who have passed on beyond school life. In all the principal cities there are public museums and art galleries, which are largely patronized, and have an elevating and refining influence. See article EDUCATION.

Religious Instruction.—The secular and non-sectari nature of the public schools does not imply that the religious instruction of the people is neglected. Churches of every known denomination are well supported. Sunday schools, Christian endeavor societies and young men's and young women's Christian Associations are well attended, and all doing good work, while the Salvation Army has its branches stretching over every part of the land, and is to be commended for its tireless endeavors to reclaim the drunkard, lift up the oppressed and to bring back to the paths of virtue and truth those who have strayed or fallen by the wayside. Temperance organizations of various kinds have many members, and are a powerful factor in preserving the better, simpler and purer life of the community. See AUSTRALIA—RELIGION.

Government Institutions.—The governments of the different states look after the poor, the sick and the afflicted. They have destitute homes where the aged are properly housed, fed and cared for. They have hospitals for the sick, where those who cannot afford to pay are nursed and attended equally with those who can. Asylums for the insane, sanatoriums for the consumptive, and homes for incurables and schools for the blind, deaf and dumb are either supported or subsidized by the governments. Genuine workingmen, if unable to obtain employment, are allowed to do certain work to pay for the food which is provided for them and their families. Such relief is of a temporary character until more permanent employment is secured.

Benefit societies and insurance companies have been established in every state, and num-

ber their members by many thousands. These have a marked effect in encouraging provident habits, and, with the temperance societies, are valuable aids in teaching frugality and moderation, which are notable characteristics in the Australians.

Old-age pensions were formerly provided by some of the states, but a system of old-age pensions is now the law for the whole Commonwealth.

Outdoor Life.—For those who are fond of an outdoor life Australia is an ideal country. The climate is such that one can practically spend the whole year in the open air. The advantages of fresh air have been wisely considered by those who had to do with laying out cities and towns, as well as those connected with the government of the country. Wide streets, squares and parks are to be found in and adjacent to all the cities, while large tracts of land have been reserved as national parks within a few miles of the centres of population.

This affords every opportunity for outdoor sport of all kinds. Rowing, football, cricket, lacrosse, golf, baseball and almost all other outside games have numerous patrons. In fact, games and sport are carried on so extensively that tourists have criticized Australians for indulging so much in them. Numerous holidays, reasonable hours for work, and long, fine days offer every inducement. Australians are decidedly a sport-loving people. The Melbourne Cup is one of the world's greatest racing events and the Flemington grounds with their commodious stands and extensive lawns are unsurpassed in any part of the world. The roads are so well made that motoring and cycling are greatly indulged in. Many residents own motors, and during the last few years money has become so plentiful that vehicles for pleasure have been purchased in large numbers.

Wealth of the People.—It is not generally known that the Australians are the richest people in the world, except the residents of England, and a good many of these draw their incomes from Australian investments. During the year (1914) Australia exported produce of a greater value than ever before. The distribution of wealth is more general than in most other parts of the world. Over 30 per cent of the adult population are possessors of property, while in England only about 12 per cent of the adult population enjoy that privilege. There are 2,108,000 depositors in the savings bank, being over 40 per cent of the entire population, and they have to their credit over $400,000,000, an average of about $200 for each depositor.

Laws and Socialism.—Taking an active and responsible part in the management of national affairs has a moderating effect upon most politicians, and to a large degree they have recognized the responsibility of office and endeavored to safeguard the country's interest.

The voice of the people can be made fully known through the ballot-box. The judgment of the public may not always be considered the wisest for the country's advancement, but when the error is discovered the same power that caused it can apply the remedy. The Australian Commonwealth franchise is the broadest and most liberal possible. Everyone over the age of 21 (except criminals and lunatics) has the right to vote. In some of the state elections as well, women have the privilege. There were many strongly opposed to woman's franchise. All the arguments about taking her from her home, destroying her womanly instincts, causing her to neglect her proper duties, etc., were indulged in. After the law was passed however, those who previously opposed it quickly realized (especially if they were parliamentary candidates) that woman was highly intelligent and that it was her duty in the interest of the country to vote.

Australia's socialism has grown with her people. It has not meant the destruction of private property. The state railways, harbors, waterworks, telegraphs, telephones, wharves, exporting departments, public schools, and other undertakings, have naturally followed one after the other, and have not been a hardship to the capitalists, but have rather been the means of allowing them to invest their money in other undertakings and thereby assist in opening up the pastoral, agricultural and mining industries.

Many of Australia's laws have been passed on the belief that the government could undertake certain things for the assistance of the people at less expense than this assistance could be carried out privately. National credit, as a rule, is much better than individual credit. Money can be borrowed by the state and lent to producers on better terms than it can be borrowed by private people for that purpose. Under certain laws the well-to-do pastoralists, as well as the poorer producer, can be assisted. It is necessary to understand Australian life to realize the need for assistance to pastoralists. The governments own most of the lands; hundreds of miles of which are let on lease to pastoralists. Wire netting has been found to be the most effective means of protecting the sheep from wild dogs, and of keeping the rabbits down. For the lessee on his own account to undertake to fence his leasehold would mean an expense which would be a heavy burden upon him, and prevent the use of his capital for other improvements; so by combining with adjoining lessees they form a vermin trust, and apply to the government for miles of wire netting; this is supplied upon the joint security of the lessees and they repay the government, with interest, in instalments extending over a number of years. Large sums have been lent in this way, but little if any loss has occurred and it has been the means of stocking much land that would otherwise have remained idle. The governments also assist the farmers by loans from state banks at low interest, a long term of years being allowed for repayments. Blockers, who only have a few acres, are also assisted, and under certain conditions they borrow from the government to help build their houses and carry out other improvements. All these loans are only granted on business principles, after the officers of the land departments have made full inquiries as to necessary security. The governments also largely assist in exporting produce and finding outside markets. This business is conducted on commercial lines, certain charges being made for the storage, freezing and work done. If the producer is in need of ready money before his goods are disposed of an advance is made by the government. All this may be considered socialistic; however upon a moment's reflection

it will be seen that it is only an assistance to further stimulate individual enterprise and effort. It has carried many a struggling producer over early years of hardship, and probably saved his property for his family when under other circumstances it might have gone into the hands of the mortgagee.

Charges, Rates, Taxes.— Railway charges are, if anything, less than on the roads owned and worked by private companies in other countries. The conveniences for traveling are good. The government control of waterworks and sewage systems for the large cities has proved economical and satisfactory. The land tax is not heavy enough to be burdensome. Municipal and local rates are low in comparison with England. The total rates in the Australian cities, including water rates, on property worth $500 per annum, would be from $50 to $100, while in and around London it would be from $150 to $300.

Employer and Employee.— The relations between the employer and the employee are generally harmonious; occasionally disputes may arise but they are nearly always settled without those long strikes which result in heavy loss to both resisting forces and engender so much bitterness of feeling. The employers as a rule pay good wages, the hours worked are short and the employees are provided with favorable sanitary and safety conditions. Being thus satisfied that their treatment is just, they in their turn do their best to give full value in their work for the wages they receive.

Literature, Art and Song.— According to Mr. Coghlan, who is a statistical authority, Australia has as large a number of first-class newspapers, considering its population, as any other country in the world, while in the matter of letter-writing the only two countries that surpass it are the United States and England.

That Australians have a taste for literature cannot be denied; what they read may not always be of the highest standard, and what they write may sometimes lack artistic finish, but one must recollect that theirs is comparatively a new country. Its real growth has taken place during the last 50 years. Other countries have not risen rapidly to literary fame. The first settlements of America were made two centuries before the world had the benefit of Irving, Longfellow, Emerson or Lowell. England's men of letters were not numerous or renowned until many generations had passed away.

While in literature Australia may not up to the present have produced writers of marked distinction, yet there are those of more or less note whose productions are of no small merit, and who have thrown the bright sunshine and free life into their work. The same may be said of art. While no one person stands out as a producer of highly valuable pictures there are several who have the true artist's spirit and have made creditable displays at the Royal Academy in London and the Salons of Paris. But when one considers musical artists, Australia has no need to feel ashamed. With the climatic conditions it naturally follows that those who are musically inclined have succeeded; and to-day, in proportion to her population, Australia is stated to have more prominent musical talent of world-wide reputation than any other English-speaking country.

Taking the residents of Australia as a whole they are a happy, prosperous and contented people. They have of course the political and theological differences which are common to all nations. The leaders of public thought endeavor to convince by reason not by force. Occasional dissatisfaction is expressed. It is questionable, all things considered, whether any country in the world is more congenial as a place of residence for the following reasons: The death-rate is lower, the primary production is greater, the wages are higher, the standard of living is better, the houses are more substantial, and surrounded with more land, the hours of labor are shorter, telegraphic communication is cheaper, the weather is brighter, the laws more liberal, the wealth more evenly distributed and class distinctions fewer than in almost any other country.

Besides all this, Australia, in the matter of language, is more English than England or America. One can hear more foreign languages spoken in New York or London in a day than could be heard in Australia in a year. Consult Taylor, 'Australia of To-Day' (1906) and Moore, 'Australian Literature and Art' (1913).

JOHN G. JENKINS,
Agent-General for South Australia, 1905–08, *and Premier*, 1901–05.

16. MILITARY AND NAVAL DEFENSE. Up to 1870 Australian defense consisted of a small garrison of British troops. These were placed in the principal cities as a kind of guard. The withdrawal of the last Imperial regiment in 1870, and the effect of the Franco-Prussian War and other European and Asiatic disturbances, led to the establishment of a colonial system of defense. The system was voluntary; men willingly came forward, gave their time and service, the governments providing them with arms and accoutrements and in many cases uniforms.

In 1880 experts from the Imperial army advised that a "Militia" or partially paid system should be substituted for the voluntary system. This was adopted about 1884. The expenditure to the colonies was increased by this system, but the general efficiency was very much greater. In most of the large schools cadet corps were established where the boys were given a regular course of drilling. The strength of the military forces in the different states prior to Federation was based upon population and amounted in all exclusive of rifle clubs to about 28,000.

Under the Constitution of the Commonwealth Act of 1900 the complete control of the defenses was transferred from the states to the Commonwealth. Under the Minister of Defense a general officer was appointed who organized and took charge of the land forces until 1905 when a Council of Defense was appointed to deal generally with questions of policy, and a military board to which the administration of the forces was entrusted. The Commonwealth was divided into six military districts generally corresponding to the boundaries of the six states. The main portion of the land forces is made up by the Citizen soldiers or militia. Over 600 professional soldiers were engaged as expert instructors spread over all the principal places in the Commonwealth. For defending the leading ports

and manning the forts permanent troops of Royal Australian garrison artillery are stationed.

The defense of Australia at present is prescribed by the Defense Acts and amendments from 1903 to 1914. In the Act of 1909 provision is made for compulsory military and naval training with the necessary regulations as regards exemption, registration and enrolment. Since then further acts have been passed extending the provisions, removing difficulties and providing necessary machinery. The geographical position of Australia instilled in the minds of the people the necessity for greater security than they felt they could depend upon in a purely voluntary system. Leading statesmen of all parties recognized the danger and the system of compulsory training above referred to was the result.

By the acts passed in 1903 and 1904 all male inhabitants in Australia between the ages of 18 and 60 were made liable for home service in time of war. It was felt that to call out men for home defense who never had been trained would not be effective, so the Compulsory Act to provide for universal liability to train in time of peace was passed, and it is worth noting that this was the first act ever passed in any English-speaking country which compels all youths to undergo a system of military training. On 1 Jan. 1911 the Compulsory Act was put in force. All male inhabitants who are British subjects and have lived in Australia for six months are liable to service. The training is as follows: (a) From 12 to 14 years of age in the Junior Cadets; (b) From 14 to 18 years of age in the Senior Cadets; (c) From 18 to 26 years of age in the Citizen Forces.

Before the Act of 1909 came into operation, at the request of the Commonwealth government, Lord Kitchener visited Australia and inspected the military forces, the forts and various defense works, and those in course of erection. He made a comprehensive report upon the whole scheme of land defense: this scheme was based upon the Commonwealth Defense Acts of 1903–09, but necessitated further amendments to those acts. The organization is based upon the following considerations: (a) The members available; (b) The length of service demanded; (c) The proportion of the various arms required.

Junior Cadets.— The training for Junior Cadets, which lasts for two years, consists of 90 hours each year and begins on 1 July in the year in which the cadet reaches the age of 12. This training is especially aimed at the development of the physique of the cadet. It consists principally of physical training for at least 15 minutes on each school day, and elementary marching drill. The following subjects are also taught: Miniature rifle shooting, swimming, running exercises in organized games and first aid. The Junior Cadets do not wear uniforms. A special staff of instructors is maintained by the government and many classes for the instruction of school teachers are held throughout the country. The teachers then instruct the boys and the inspectors of the schools supervise the training and inspect the boys on behalf of the military authorities.

Senior Cadets.— The training of Senior Cadets, which lasts for four years, commences on 1 July in the year in which the cadet reaches the age of 14. It consists of at least 40 drills each year, of which four are classed as whole days, 12 as half days, the remainder being night drills of not less than one hour. The four years' training comprises marching, handling of arms, musketry, physical drill, first aid, guards and sentries, technical training as a company in elementary field work and elementary battalion drill.

Adult Forces.— Training in the Citizen Forces, which covers a period of eight years, begins on 1 July of the year in which he reaches the age of 18 years. The work consists of training continuously in camp for 17 days in the case of the naval forces, artillery and engineer arms, and eight days for other arms and eight days' home training for all arms. The total service is 25 days per annum. Persons, if by their religion they are not allowed to carry arms, as far as possible are allotted to duties of non-combatant character such as stretcher bearers, or as members of the Army Medical Corps, necessary proof being required to secure exemption. Heavy penalties are provided by act for evasion or prevention from service. Efficient parades must be attended and a standard of efficiency attained by all the trainees each year.

Pay.— All members of the militia are provided with certain payment. Citizen soldiers who enlisted voluntarily under the old system have the same rate of pay as formerly, the basis being 8/– per day for gunners, sappers or privates. Under the compulsory system they receive 3/– per day during the first year and 4/– per day during the following years of their training. Non-commissioned officers and officers are paid as follows: Corporals, 9/– per day; Sergeants, 10/– and 11/– per day; Lieutenants, 15/– per day; Captains, 22/6 per day; Majors, 30/– per day; Lieutenant-Colonels, 37/6 per day; Colonels, 45/– per day; mounted officers also receive horse allowance.

Uniforms are provided free for use on drills and parades, but are not permitted to be worn when the cadets or soldiers are not on duty. The Citizen soldiers have rifles issued to them, but the arms for the Senior Cadets are kept at local depots and issued as required for musketry practice and drill. An allowance of free ammunition is provided to encourage rifle shooting. The Commonwealth government has established factories for the manufacture of all military equipments.

In addition to those who are undergoing regular training there are nearly 1,200 rifle clubs in Australia with a membership of about 50,000. An annual course of musketry is fired by these members but they do not undergo any systematic course of training. It is estimated that 60 per cent of the members of these rifle clubs are fit for active service.

A Royal Military College was established in 1911. The ordinary college course lasts for four years and when completed those who have passed through go for a period on duty to England or India, after which they are appointed to positions on the staff or with the permanent troops in Australia or New Zealand. During the European War, which commenced in August 1914, the course at the Military College has been temporarily modified. No fees are charged for instruction and maintenance, each staff cadet being credited to meet necessary expenses

of uniforms, books, instruments, etc., with an allowance of 5/6 per day. Both educational and military work are comprised in the course of instruction. Cadets are prepared for engineer, artillery, light horse and infantry work.

The working of the compulsory training system is proving most successful. The number in training in 1914 was Citizen soldiers, 51,000; Senior Cadets, 87,000; Junior Cadets, 50,000; nearly 200,000 in all in actual training. G. H. Knibbs, Esq., C.M.G., the Commonwealth statistician (to whose works the writer of this article is greatly indebted), deals with the success of the Australian system. "The scheme both before its inception and since its successful inauguration has had the support of leading statesmen of all political views as well as the vast majority of the citizens of the Commonwealth. In general the trainees are alert and well disciplined while on parade, and their interest and enthusiasm is shown by the large number of candidates seeking promotion at competitive examinations after courses of lectures, demonstrations and special parades. A great deal of voluntary service is rendered in all branches of the service and the rifle clubs of the Citizen Units are well patronized. Many of the regiments have athletic, gymnastic and swimming clubs and sports meetings are frequently held. Moreover, a marked improvement has become apparent in the general conduct and bearing of the youths of Australia, and it is claimed that this is the effect of the system of universal training. As a result of enquiries made in 1914, the police authorities in all the states concurred in the opinion that the behavior of the youths who are subject to the training is vastly improved. It is stated that both mentally and morally as well as physically the benefits are very definite and that "the principal effects of a beneficial nature are increased self-respect, diminution of juvenile cigarette smoking, and generally a tendency toward a sense of responsibility and a desire to become good citizens."

Naval Defense.— Prior to the Federation of the Australian states the naval defense was chiefly provided by a British squadron located in Australian waters with Sydney as its base, Australia and New Zealand providing a portion of the expense to the British government. In addition to this the states had provided at their own expense several small vessels, gunboats, etc. After the Commonwealth was established it was considered that Australia should take a greater part in naval defense so it was decided in 1909 to create an Australian naval force to replace the squadron previously maintained under the agreement with the British government. The Australian government invited Admiral Sir Reginald Henderson to visit Australia and advise on naval matters generally. His scheme has been principally adopted. It provides for 52 vessels and 15,000 men. Expenditure on construction works extending over 20 years £40,000,000 with an ultimate annual naval vote of nearly £5,000,000. The 52 vessels would consist of 8 armored cruisers, 10 protected cruisers, 18 destroyers, 12 submarines, 3 depot ships, 1 fleet repair ship. Six naval bases and 11 sub-bases were recommended. The Australian navy in April 1915 consisted all told of about 20 vessels varying in size from a gunboat of 360 tons to the battle cruiser of 19,200 tons, aggregating about 60,000 tons or an average of 3,000 tons per vessel.

In the great war the Australian navy by its prompt and effective action rendered valuable service in clearing the islands of the Pacific of German ships. The most spectacular feat was the destruction of the commerce raider *Emden* by the light cruiser *Sydney*, after the former had destroyed, principally in the Indian Ocean, 21 British vessels valued between two and one-half and three million pounds.

The Australian forces rendered valuable aid also in the campaigns in Egypt, Mesopotamia, Gallipoli, Macedonia, and the western front. An army of about 300,000 was raised, the majority of whom saw actual service with the British and French forces, and much of the credit for the prompt way in which they adapted themselves to modern warfare is undoubtedly due to the national system of compulsory training in Australia. That the quality of the troops was of the best was evidenced by the frequency with which they were mentioned in dispatches. See WAR, EUROPEAN.

Bibliography.— Beaumont, 'Naval Defense of Australia' (1901); De Thierry, 'The Naval and Military Forces' (1914); Edmund, 'The Australian Fleet' (1911); Foster, 'The Defense of Australia' (1908); Hythe, 'Australia and Imperial Defense' (1913).

Hon. J. G. JENKINS,
Minister of Defense, South Australia, 1899 *to* 1901, *Premier* 1901 *to* 1905, *Agent-General* 1905–08, *Hon. Treasurer Australian War Contingent Association.*

AUSTRALIA, South, one of the original states in the Commonwealth of Australia. It occupies the middle of Australia, and at first, as the colony of South Australia, extended between long. 132° and 141° E., and from Southern Ocean to lat. 26° N., having then an area of about 300,000 square miles. In 1861 a district lying to the west of the colony was added to it, so that its western boundary was shifted to the meridian of 129°. In 1863 it received in addition the country between its northern boundary and the opposite coast (this portion being now known as the Northern Territory), so that South Australia now possesses a territory extending across Australia, and occupying an area estimated at 903,690 square miles. It is bounded on the east by Victoria, New South Wales and Queensland; on the west by West Australia. Its greatest length from north to south is 1,850 miles, and its width 650 miles. The south coast, for the first 120 miles east of where it begins at Port Eucla, is backed by steep limestone ranges from 400 to 600 feet in height, but as a whole the coast is low and desolate-looking. In a straight line from Port Eucla on the west to Cape Northumberland, near the boundary of Victoria, the distance is 850 miles, but the coast-line between these points extends to nearly twice that distance, owing to the indentations of Spencer Gulf and the Gulf of Saint Vincent. Opposite the latter is Kangaroo Island, the largest island on the Australian coast, excepting Tasmania. The coast of the Northern Territory is thickly strewn with islands, three of which are of large size. There are also some excellent ports, one of these, Port Darwin, where the overland telegraph and the cable from Batavia and the East

meet, being among the finest harbors in Australia. On the eastern side of the Gulf of Saint Vincent lie the most populous portions of the state, and here is situated Adelaide, the state capital, with a population in 1911 of 189,646.

The interior formation of South Australia widely differs from that of the most eastern states. The mountains here run from the sea to the interior, ending somewhat abruptly among the lakes. The principal chain, the Mount Loftv Range, begins at Cape Jervis, and follows the shore of the Gulf of Saint Vincent past Adelaide, meeting at the head of the gulf, the ridges forming the backbone of Yorke Peninsula. The range still running north is called Flinders Range, and ends in a wide mass of mountain 3,000 feet high, separating the lakes Torrens, Eyre, Frome and Blanche. All these so-called lakes are huge expanses of salt water swamp and mud. On the west of Spencer Gulf is Eyre Peninsula, through the heart of which runs the Gawler Range, attaining an elevation of 2,000 feet, and ending on the shores of another series of lakes of the same character as Lake Torrens. The principal summits of the Mount Lofty Range are Razor-back, in latitude 33° 20′, and immediately north of it Mount Bryan, close to which is the celebrated Burra-Burra copper mine. The highest peaks of the Flinders Range are Mount Remarkable, 3,179 feet, Brown 3,174 feet, and Arden 3,000 feet. None of the peaks in the Gawler Range attain more than a moderate elevation. On the left bank of the Murray, and near its mouth, a range of moderately elevated heights proceed south-southeast, skirting the coast to its extremity near Cape Northumberland. Throughout these ranges the existence of volcanic agency at a former period is everywhere apparent. The Warburton Range and the Stuart ranges lie beyond and to the north and west of the lakes; further north on the Tropic of Capricorn are the MacDonnell ranges, rising to a height of 4,000 feet, from which the extreme western affluents of the Lake Eyre River system take their rise. The other portions of the territory to the north and west are almost level, and consist of either waterless plains or plains of sandstone boulders, with desert grass and spinifex.

Among the mountains east of Gulf of Saint Vincent, primitive limestone, often in the form of a beautiful white marble, is very abundant. There are indications of a large variety of minerals throughout the state, but copper is the only one that has been met with in large quantities. The total mineral production to the end of 1907 was valued at £913,863, of which £714,525 represented copper and £36,602 represented gold. In 1913 the total mineral production was £584,458. In the Northern Territory gold has also been found over a considerable tract of country, and good progress has been made in mining while other minerals are known to exist. Almost the only stream within the state proper, which deserves the name of river, is the Murray, which enters the colony on the east in latitude 34°, and flows first circuitously west and then south, into the extensive lagoon called Lake Alexandrina, communicating with the sea by a narrow opening. During the rainy season it is navigable by steamers through its whole course within the state, and for 1,500 miles in New South Wales. In the Northern Territory the Roper River is a fine large stream, navigable for sea-going vessels for 100 miles from its mouth in the Gulf of Carpentaria; the Victoria is also navigable. The climate of South Australia proper greatly resembles that of Sicily and Naples. During nine months of the year it is agreeable, the disagreeable portion of the year being the three summer months of December, January and February, when the natural heat of the season is greatly increased by hot winds from the interior. What is called winter would be considered in England merely a wet autumn. There are no epidemic diseases. Scrofulous and tubercular diseases are rare, but diseases of the eyes are common in summer, being either occasioned bv the impalpable dust floating in the atmosphere, or by exposure to the night air after the glare of the sun.

South Australia produces nearly all the fruits and vegetables that are cultivated in Europe as well as others, but in temperate regions is chiefly distinguished as a wheat and grape-growing country. Besides supplying its own wants, it sends large quantities of wheat to the neighboring states and to Europe, where "Adelaide" wheat is held in high estimation. The area under wheat is about 2,190,782 acres. The quantity produced varies greatly with the season, but the average production is six bushels per acre. The area under vineyards is gradually extending, and now approaches 25,000 acres. In 1912 the total area under cultivation was about 3,000,000 acres, of which 107,881 acres were in oats; 40,643 acres in barley; 23,214 acres in fruits; 521,182 acres in hay and 7,412 acres in potatoes. Brandy is produced as well as wine. Hop-growing is attracting some attention, and the olive is also cultivated. The chief exports are wool, wheat, flour, copper and copper ore, skins, etc. The trade of a large part of New South Wales passes through South Australia. The revenue in 1912 was £4,450,739, the expenditures being the same. The length of railways in 1912 was 2,168 miles. There is a complete system of telegraphs, besides the great line from Adelaide across the continent to Port Darwin, a distance of 2,000 miles, which is almost completed. The public debt of the state is £31,118,574 and has been mostly incurred for reproductive public works. In 1912 there were 768 schools, 1,473 teachers and 58,273 pupils. The total population in 1914 was 438,173, not including aborigines. See AUSTRALIA — POLITICAL HISTORY; AUSTRALIAN FEDERATION.

AUSTRALIA, West, one of the original states in the Commonwealth of Australia. It includes that portion of Australia west of long. 129° E., and is bounded, east by South Australia, and northwest and south by the Indian Ocean. It lies between the parallels of 13° 30′ and 35° 8′ S.; greatest length, 1,450 miles north to south; greatest breadth, 850 miles; area, 975,920 square miles. The coast-line measures about 3,000 miles, and except on the south is indented by numerous bays, creeks and estuaries. The coast is fringed by many islands, but none of any importance. The principal inlets are Cambridge Gulf, Admiralty Gulf, York Sound, Collier Bay, King Sound, Roebuck Bay, Exmouth Gulf, Shark Bay, Geographe Bay and King George Sound, the last the most

important as having Albany on its shore, the port of call for the European mail steamers. The chief rivers are the Ord and Fitzroy on the north, De Grey, Ashburton, Fortescue, Gascoign, Murchison, Greenough, Swan and Blackwood on the west. The Swan River is important as Perth, the capital, is situated on its banks. Some of the rivers within the tropics are large and navigable, but few of the others run all the year, and fewer still are navigable even for boats to any great distance. The interior was till recent years not well known, but at present there is little territory which has not been explored. The country is chiefly an alternation of ridges and hollows, sandy, without grass, and clothed with bushes and scrubby timber, without the trace of a water-course. The really settled and occupied portion of the state forms only a mere fraction of its whole area. The population is mostly collected in the southwest corner, where the first settlements were made, and around the recently discovered gold reefs. Scattered settlements stud the coast at various points. On the west coast are extensive banks covered with the pearl oyster, which give employment to a fleet of boats. The Kimberley district in the north is a region of great promise; it comprises 20,000,000 acres of well-watered land intersected by the Fitzroy River and other large streams, and is said to be admirably adapted for pastoral purposes, besides having a large area suitable for the cultivation of sugar, coffee and rice. The greater part of the seaboard, except along the Australian bight, is separated from the interior by a low range of hills running parallel to it, and covered with forests. The fertile land exists in patches, and some of it is of a very rich character. The principal crops are wheat, barley, hay and potatoes; the vine is also successfully cultivated, and excellent wine is made in the colony. The area under cultivation comprises about 1,072,000 acres, of which wheat occupies 612,104 acres, hay 344,032 acres, oats 77,488 acres and fruit 18,194 acres. An available area of 1,000 square miles is covered with jarrah forests. The jarrah is a species of eucalyptus (*E. marginata*); its timber is in great request for railway sleepers, for building purposes, and especially for marine constructions, having the valuable property of resisting the attacks of the white ant on land and the ship worm at sea. Considerable areas in the southwest are covered with karri (*E. diversicolor*). There are also numerous forests of sandalwood trees, the timber of which is exported in large quantities, chiefly to China for incense purposes. Flowers and fruits from all quarters of the globe grow luxuriantly. Among the fruits successfully cultivated are apples, pears, oranges, peaches, plums, apricots, figs, almonds, bananas, olives, etc. English vegetables may be profitably cultivated at almost all seasons. Bees thrive and produce abundant stores of honey.

The mineral resources of the state are not yet fully known. Gold has been discovered in large quantities, and West Australia is now the chief gold-producing state of Australia, the Coolgardie gold fields being among the most productive. Its gold production to 1908 amounted to 20,011,698 fine ounces, valued at £85,004,290. In 1908 it was 1,647,912 fine ounces and valued at £6,999,885. But in 1913 its total product of minerals was only £5,760,207, from which it is obvious that the production of gold has declined. Lead and copper exists abundantly, and several mines are in operation. Iron ore might be raised in almost inexhaustible quantities, and tin also exists. The gold discoveries have formed an epoch in the history of the state, and trade and population have recently increased very rapidly. Besides gold the exports include wool, jarrah and karri timber, sandalwood, pearls, pearl shells, tin ore, skins, etc. The revenue has grown enormously. In 1881 it was £206,205; in 1891, £497,670; and in 1912 it was £3,966,673, the expenditures being £4,101,082. The public debt in 1912 was £23,364,790. There were, in 1914, about 2,967 miles of railway open. The principal towns are Perth, the capital, with a population in 1911 of 106,792. Freemantle is the port of entry. The population of the whole state in 1914 was 323,952. In 1912 there were 536 schools, 1,189 teachers and 38,184 pupils. The first part of the state settled was the southwest corner, long known as the Swan River Settlement, established in 1829. From 1850 to 1868 it was a place for the transportation of convicts. In 1890 the state received a system of responsible government similar to that prevailing in the other colonies of Australia. See AUSTRALIA — POLITICAL HISTORY.

AUSTRALIAN ALPS, a range of mountains in the southeast of Australia, extending over a length of about 400 miles. The highest peaks are in New South Wales, and the highest, according to Lendenfeld, is Mount Townshend (7,353 feet), belonging to a group which he calls the Kosciusko group. The peaks next in height belong to the Bogong group in Victoria, and the west of the Mitta Mitta, the highest of which is Mount Bogong (6,508 feet). They do not reach the snow line, though snow lies in the higher valleys all the summer. Geologically, the Australian Alps are composed mainly of very ancient metamorphic rocks, which have been worn down in the course of ages to table-lands, and which slope down rather steeply on all sides. Volcanic rocks cover the table-land to the south of Mount Bogong.

AUSTRALIAN BALLOT. See BALLOT.

AUSTRALIAN FEDERATION, the political union of the five Australian colonies, together with Tasmania. The first convention looking to this end was held at Hobart in January 1886. The colonies represented were Victoria, Queensland, Tasmania, Western Australia and Fiji. Another conference took place in 1891, at Sydney, New South Wales, attended by delegates from each of the colonies. A plan of Federal government was proposed, resembling in many of its features that of the United States. A draft bill to constitute the Commonwealth of Australia was adopted by the convention, and it was agreed to submit it to the approval of the individual legislatures of the several colonies. This bill met with success in the lower branch of but one colonial legislature — that of Victoria. In January 1895 there was a conference of premiers of five colonies at Hobart, and the Legislative Assembly of New South Wales passed a Federal Enabling Act in November of that year, and notice of motion was given in other legislatures to bring in a similar bill. The first practical step was taken

in 1898. A convention of representatives of New South Wales, Victoria, Tasmania, South Australia and Western Australia succeeded in drafting a Constitution, which was submitted to the popular vote of each of those colonies in June. The Constitution provided for a governor-general, appointed by the Crown; a Federal Parliament, composed of the Crown, represented by the governor-general, a Senate and a House of Representatives. The powers of the Parliament were set forth in 39 articles, and covered trade with other countries, taxation, coinage, weights and measures, foreign corporations, pensions, arbitration, etc. Free trade between the states was recognized. By the terms of the plebiscite, an affirmative vote of substantially one-third of the electors of New South Wales, and of one-fifth of the electors of each of the other colonies, was required to adopt this Constitution. But the election returns in June were fatal to the scheme. While the majorities in the four lesser colonies were overwhelmingly in favor of the Constitution, the requisite affirmative vote in New South Wales was not obtained.

On 2 Feb. 1899, a unanimous agreement was reached by the colonial premiers in conference at Melbourne, regarding the unsettled questions referred to them by the colonial legislatures, thus insuring the success of the Federation project. In 1900, a bill making Federation effective was introduced into Parliament, at London, and passed, the only amendment offered having reference to the royal prerogative. On 1 Jan. 1901 the Australian Commonwealth was proclaimed. So similar in character is the Constitution of the Australian Commonwealth to that of the United States that there can be no doubt that the former is modeled very largely after the latter. This is especially obvious in the matter of states' rights. Evidently there is in Australia that same tendency toward local autonomy that is here represented by the principles of Thomas Jefferson.

The Australian Constitution provides for a Parliament very similar to the United States Congress, comprising a Senate and a House of Representatives. In place of the President there is the governor-general, appointed from London, who has the power to summons, to prorogue or to dissolve Parliament, though it must meet every year. There are six senators from each of the six states, elected by the people for a term of six years each. The representatives are elected for terms of three years, also by direct ballot, and it is so arranged that they shall always number twice as many as the senators. By a majority vote Parliament may increase or decrease either chamber, though it may not interfere with the proportion of any state's representation in the House without that state's consent.

Although the principle of states' rights is fundamental, the Australian Parliament has a wider scope of legislative activity than has the Congress of the United States. It has the power to legislate on marriage, divorce, bankruptcy and incorporation of commercial enterprises. It has the power to levy taxes, direct or indirect; it may regulate foreign or interstate commerce, may enforce arbitration in disputes between states or industrial organizations; the Federal government may carry on banking, insurance, may establish old-age pensions, has control and may acquire the telegraphs, telephone systems, the railroads, etc. And where state laws come in conflict with Federal laws, the former are void. Legislation may originate in either House, but money bills must originate only in the House of Representatives. The Senate may reject a House bill, but it may not amend it. Should the Senate persist in rejecting certain legislation passed by the House, and thus cause a deadlock, Parliament automatically dissolves and a new election takes place.

The judicial power of the Federation is represented by the High Court of Appeals, corresponding to the Supreme Court of the United States. This court hears appeals from the state Supreme Courts or the minor Federal courts. An appeal from the High Court may, however, be carried to London in matters not involving the Constitution. It was at first intended to limit this right of interference on the part of the home government to matters affecting other parts of the British empire, but certain compromises were made on both sides. On the whole, however, the Australian Federal government is practically independent, and the power of the home government and the governor-general is limited almost entirely to the veto.

On 9 May 1901 the 1st Parliament opened in Melbourne, which was made the temporary capital. The Earl of Hopetoun was appointed the first governor-general. The following year he resigned and was replaced by Baron Tennyson, who was replaced by Baron Northcote in 1904. In 1908 the latter gave place to the Earl of Dudley. Ronald Munro-Ferguson was appointed governor-general in May 1914. He is assisted by a cabinet of seven members, appointed by himself.

On 5 Dec. 1910 New South Wales agreed to cede to the new Federal government 912 square miles of territory in the Yass-Canberra district, which is to be a Federal district, corresponding to the District of Columbia in the United States. In 1913 work was begun on the building of the capital for the Federal government; this city is to be known as Canberra (q.v.). At present the population of the whole Federal district is only 2,868. In 1915 the customs revenue of the Australian Federal government was £11,702,000. Consult Quick, 'The Annotated Constitution of the Australian Commonwealth' (Sydney 1901); Turner, 'First Decade of the Australian Commonwealth' (New York 1911).

AUSTRASIA, âs-trā'shĭą (the East Kingdom), the name given, under the Merovingians, to the eastern possessions of the Franks, embracing Lorraine, Belgium and the right bank of the Rhine. These districts, thickly inhabited by Franks, were of great importance at the time of the rise of the Frankish power.

AUSTRIA-HUNGARY (Oesterreich-Ungarn), officially designated THE AUSTRO-HUNGARIAN MONARCHY, an empire of central Europe, consisting of two semi-independent countries, each according to the *Ausgleich* or Compromise of 1867 having its own Constitution, a limited monarchy and separate Parliament, but each united in the conduct of foreign affairs and in the establishment of a common army and navy under one ruler: "His Apostolic

Majesty the Emperor of Austria and the King of Hungary."

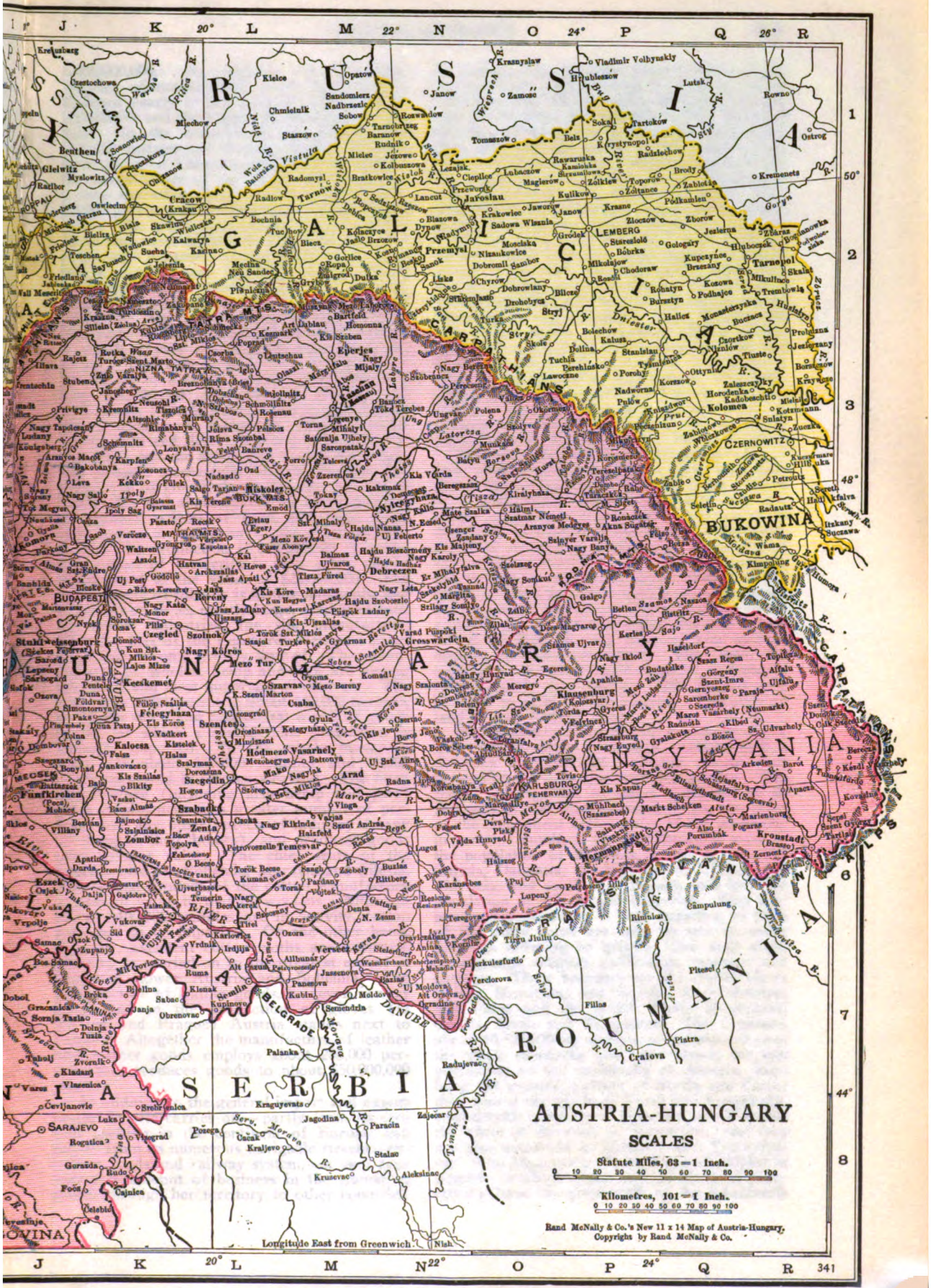
Area and Divisions.— The Austrian empire extends from about lat. 42° to 51° N., and from long. 8° 30′ to 26° 30′ E.; the total area in round numbers is 240,000 square miles. Its greatest length from east to west is about 860 miles; its greatest breadth about 400 miles. It is bounded south by Montenegro, Serbia, Rumania, the Adriatic Sea and the kingdom of Italy; west by Switzerland, Bavaria and Saxony; north by Prussia and Russian Poland; and east by Russia and Rumania. On the shores of the Adriatic, along the coasts of Dalmatia, Croatia, Istria, etc., lies its only sea frontage, which, compared to the size of the monarchy, is of insignificant extent. Besides being divided into the two great divisions above mentioned, the Austro-Hungarian monarchy is further divided into a number of governments or provinces. The following table exhibits the name and area of these governments, with their population in 1900 and 1910:

Divisions.	Area in sq. m.	Population. Dec. 31, 1900.	Population Dec. 31, 1910.
Austrian Provinces —			
Lower Austria	7,654	3,100,493	3,531,814
Upper Austria	4,631	810,246	853,006
Salzburg	2,767	192,763	214,737
Styria	8,670	1,356,494	1,444,157
Carinthia	4,005	367,337	396,200
Carinola	3,856	508,150	525,995
Coast land	3,084	756,546	893,797
Tyrol and Vorarlberg	11,324	981,989	1,092,021
Bohemia	20,060	6,318,697	6,769,548
Moravia	8,583	2,437,706	2,622,271
Silesia	1,987	680,422	756,949
Galicia	30,307	7,315,816	8,025,675
Bukowina	4,035	730,195	800,098
Dalmatia	4,940	593,783	645,666
	115,903	26,150,597	28,571,934
Hungary			
Hungary and Transylvania	109,188	16,838,255	18,264,533
Croatia and Slavonia	16,421	2,416,304	2,621,954
	125,609	19,254,559	20,886,487
Bosnia	16,239.4	1,348,581	1,631,006
Herzegovina	3,528.5	219,511	267,038
Military	.....	22,944	33,758
	19,767.9	1,591,036	1,931,802
Empire	261,279.9	46,996,192	51,390,223

Natural Features.— Although presenting every variety of surface the prevailing character of the Austrian dominions is mountainous, there being few districts where mountains are not found; while the plains do not occupy more than a fifth part of the whole superficies. The loftiest ranges, and the most extensively ramified, are found in Tyrol, Styria, Illyria and the southern parts of Austria proper. In some of these regions the scenery is bold and romantic, and has been considered equal to that of Switzerland. The most extensive tracts of low or flat land occur in Slavonia and the southeast and central parts of Hungary; much of this level land is remarkably fertile, but it is met at various points by vast morasses and arid steppes. The principal valleys are found in Tyrol, Salzburg, Styria and Illyria. Extensive plains stretch along the courses of the rivers, particularly the Danube, the Theiss and the March. The principal rivers of Austria are the Danube, the Elbe, the Save, the Drave, the Waag, the March, the Inn, the Teiss or Theiss and the Maros. The Danube for upward of 800 miles is navigable for quite large vessels throughout the whole Austrian territory; while all the others, most of them tributaries of the Danube, are navigable for vessels of smaller size. All the rivers abound in fish. The lakes are numerous and often picturesque, although those in the lowlands, particularly in the plains of Hungary, are rather marshes than lakes. Austria lies between the isotherms of 60° and 50°, and has a climate nearly as various as its surface. The northern regions, between the 49th and 51st degrees of north latitude, have an average temperature resembling that of the north of France. Between lat. 46° and 49° the heat is considerable; and between 42° and 46°, which comprises the whole of south Austria, it is still greater; the winter lasting two or three months only, and being, in general, extremely mild. The principal products of the north are wheat, barley, oats and rye which are so plentiful that the greater part of them is exported abroad; in the centre, vines and maize are added; and in the south, olives. The productive capabilities of the soil have undergone considerable development in recent decades. The wines of Austria are inferior on the whole, with exception of a few choice kinds, including the well-known Tokay. A great portion of the worst wine is made into brandy. The produce of wine annually has reached over 240,000,000 gallons, of which Hungary yields by far the largest proportion. The forests cover 69,000 square miles, or one-third of the productive soil of the empire, and yield timber of excellent quality, adapted for all purposes. Wild deer, wild swine, chamois, foxes, lynxes and a species of small black bear, are found in many districts, the fox and lynx being particularly abundant. Herds of a native breed of horses, of small size, roam wild over the plains of Hungary. All the domestic animals of England are known throughout the empire. A large portion of the countries now composing the Austrian empire was at one time submerged by the sea, particularly Hungary, where the general appearance of its vast plains, the nature of their soil, and, above all, the occurrence of fossil sea shells, leave no room to doubt the former dominion of the ocean. Throughout all Austria the Tertiary formation prevails, with a margin of the Secondary formation, stretching to a greater or lesser extent into the surrounding countries, and diversified by patches of igneous rocks of the Tertiary and Alluvial epochs. In mineral productions Austria is very rich, possessing, with the exception of platinum, all the metals, particularly gold, silver, iron, copper, lead, zinc, quicksilver, coal and salt. The total annual value of the mineral products of the Austrian empire is estimated at upward of $74,288,500; of which $34,466,883 represents coal; $29,894,429 lignite.

Manufactures and Commerce.— Manufactures are in the most flourishing condition in Bohemia, Moravia, Silesia and Lower Austria; less so in the eastern provinces, and insignificant in Dalmatia, Bukowina and the military frontiers. The total money value of manufactured products amounts to at least $500,000,000, the value of agricultural products to more than

CONTINUATION OF
DALAMATIA AND HERZEGOVINA
ON SAME SCALE.


AUSTRIA-HUNGARY
SCALES
Statute Miles, 63 = 1 Inch.
0 10 20 30 40 50 60 70 80 90 100
Kilometres, 101 = 1 Inch.
0 10 20 30 40 50 60 70 80 90 100
Rand McNally & Co.'s New 11 x 14 Map of Austria-Hungary.
Copyright by Rand McNally & Co.
Longitude East from Greenwich
GALICIA
BUKOWINA
TRANSYLVANIA
HUNGARY
SERBIA
ROUMANIA
CROATIA-SLAVONIA
DALMATIA
BOSNIA
HERZEGOVINA
CZERNOWITZ
LEMBERG
BUDAPEST
DANUBE
CARPATHIANS
BELGRADE
SARAJEVO
KARLSBURG
Cracow
Lemberg
Przemysl
Debreczen
Temesvar
Arad
Szegedin
Kecskemet
Szolnok
Grosswardein
Klausenburg
Hermannstadt
Kronstadt
Marienburg
Agram
Essek
Semendria
Palanka
Kragujevats
Jagodina
Parcin
Nish
Cralova
Pitesci
Campulung
Tirgu Jiulu
Verciorova
Orsova
Radujevac
Stalac
Aleksinac
Krusevac
Kraljevo
Cacak
Uzice
Visegrad
Rogatica
Foca
Gorazda
Cajnica
Celebic
Cevljanovic
Srebrenica
Vlasenica
Zvornik
Tabolj
Kladanj
Sarajevo
Luka
Brcka
Gradacac
Dobol
Sabac
Obrenovac
Mitrovica
Ruma
Klenak
Karlovitz
Irdilja
Vrdnik
Alt Pasua
Albunar
Versecz
Panesova
Kubin
Jassenova
Moldova
Ujmoldova
Alt Orsova
Geradine
Semendria
Fillas
Pistra
Radujevac
Zajecar
Parcin
Jagodina
Kragujevats
Palanka
Semendria
Obrenovac
Sabac
Janja
Sornja Tasla
Dolnja Tuzla
Brcka
Gradacac
Dobol
Samac
Bos. Samac
Orasje
Derventa
Modrica
Maglaj
Zepce
Doboj
Teslic
Banja Luka
Jajce
Travnik
Zenica
Kiseljak
Konjica
Mostar
Gacko
Trebinje
Ragusa
Cattaro
Castelnuovo
Risano
Cetinje
Podgoritza
Scutari
Spalato
Sebenico
Zara
Knin
Sinj
Imoski
Metkovich
Gravosa
Ragusa
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Gravosa
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Peterwardein
Mitrovitz
Semlin
Belgrade
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Fillas
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Cralova
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Krusevac
Kraljevo
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Cajnica
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Metkovich
Gravosa

$1,000,000,000. As regards the individual branches of manufacture, there are machines produced yearly to the value of $20,000,000 to $25,000,000, and the supply about equals the demand. In the manufacture of musical and scientific instruments Austria holds a high position; those of Vienna are especially celebrated. The manufacture of stoneware and chinaware is very extensive, being valued at about $12,500,000 yearly, and giving rise to a brisk export trade. The glass manufacture is one of the oldest and most highly developed branches of industry in Austria. The manufactories, about 200 in number, are spread over the entire monarchy, but are most numerous in Bohemia, where glass and glasswares of every kind are produced. The yearly value of this class of manufactures is estimated at about $12,500,000, of which a very considerable quantity is exported. The manufacture of metal goods is carried on to a great extent, being valued at about $50,000,000; and some of the iron and steel goods, such as scythes and reaping hooks, have a world-wide reputation. The manufacture of gold and silver plate and jewelry is also important, and the articles of Vienna workmanship compete successfully with the French. The production of chemicals reaches the amount of $25,000,000, and about covers the home demand. As regards articles of food, the sugar from beets has an annual value of about $60,000,000; of beer the production is $20,000,000 in value, the number of breweries is over 2,000; spirits are distilled to the value of $20,000,000. The manufacture of tobacco is a state monopoly, and is carried on in 38, mostly large, establishments. Of textile industries, the silk manufacture, since the loss of the Lombardo-Venetian provinces, has become greatly limited. The manufactures of woolen, hemp and flax are among the oldest and most important of the state. The first gives employment to about 400,000 persons, and turns out about $70,000,000 worth of goods yearly, of which a considerable proportion is annually exported. In the whole monarchy there are about 650,000 spindles and 65,000 looms employed in woolen weaving. The linen manufacture (including also hemp and jute) gives employment to a greater number of persons than any other branch of industry (many of them in their homes), and produces goods to a greater value. The chief seats of the manufacture are Bohemia, Moravia and Silesia. The annual produce of the cotton manufacture is next in value to that of woolens. Although about 2,400,000 spindles are in activity, cotton yarn has to be imported. On the other hand, however, excellent cotton cloths are exported. Tanning is carried on to the greatest extent in Moravia, Lower Austria and Bohemia. The manufacture of leather goods, however, is very large, and in the production of gloves (in Vienna and Prague) Austria stands next to France. Altogether the manufacture of leather and leather goods employs about 200,000 persons and produces goods to about $50,000,000 yearly.

In addition to the general import and export trade, Austria carries on,—partly from its central position in the continent of Europe, and partly from its numerous navigable streams, excellent roads and railway system,—a very considerable amount of business in the transit of goods through her territory to other countries. In recent years the total annual value of the imports into Austria-Hungary was, in round numbers, $730,500,000, while the value of the exports reached $591,000,000. The principal imports are raw cotton, wool, cotton and woolen yarn, silk and silk goods, coffee, tobacco leaf, furs and hides, leather, machinery, locomotives, etc., hardware and clocks, books, newspapers, maps, grain and cattle. Wood formed the chief article of export, next came sugar, cattle, grain, leather and leather wares (including gloves), hardware, eggs, coal and coke, woolen manufactures, glass and glassware, paper and paperwares, wool, malt, wooden goods, hides, etc. Nearly one-half of the commerce of Austria is carried on with Germany, the next places being occupied by Great Britain, Italy, Russia and the United States. Including fishing vessels and small craft, Austria-Hungary, in 1913, had 17,297 vessels of all sizes, with a tonnage of 610,541, and employing 48,698 men. The principal ports of the empire are Trieste, Pola and Fiume. In 1913 there were 27,845 miles of railway open for traffic in the empire, of which 14,512 were in Austria, and 13,333 in Hungary.

Money, Weights and Measures.—On 1 Jan. 1900 a new monetary system went into effect, the coinage being changed from a silver to a gold basis, and the standard coin and money of account being the crown (equal to 20.3 cents in United States gold). Practically the chief medium of exchange is banknotes, of various denominations. The Austrian centner, the weight by which all large quantities are rated, is 123½ pounds avoirdupois. The metze (pl., metzen), the largest dry measure = 1.7 of a bushel, or somewhat less than the fourth part of an English imperial quarter, nine metzen making two quarters nearly. The eimer, the most generally used liquid measure, is equal to 14.94 English wine gallons. The Vienna foot is equal to 12.45 inches English. The joch of land is 1.43 English acre.

Population.—None of the European states, with the exception of Russia, exhibits such a diversity of race and language among their population as does the Austrian empire. The Slavs, who amount to about 19,000,000, or 45 per cent of the total population, are the chief of the component nationalities of the monarchy in point of numbers, forming the great mass of the population of Bohemia, Moravia, Carniola, Galicia, Dalmatia, the kingdom of Croatia and Slavonia, and southern Hungary, and half the population of Silesia and Bukovina. This preponderance, however, is only apparent, as none of the other races are split up into so many branches differing so greatly from each other in language, religion, civilization, manners and customs. These branches are the North Slavic Czechs, Moravians and Slovaks, the Ruthenians and Poles and the South Slavic Slovenians, Croats, Serbs and Bulgarians. The Germans, about 10,570,000 in number, are scattered over the whole monarchy and form almost the sole population of the archduchy of Austria, Salzburg, the greatest portion of Styria and Carinthia, almost the whole of Tyrol and Vorarlberg, considerable portions of Bohemia and Moravia, the whole of the west of Silesia, etc.; and they are also numerous in Hungary and Transylvania. The Magyars or Hungarians (7,440,000 in number, or about 16 per cent of the total population) form the great bulk of the inhabitants

of the kingdom of Hungary and of the eastern portion of Transylvania. To the Italic or western Romanic stock belong the inhabitants of south Tyrol and parts of the coast lands and Dalmatia, numbering about 700,000 in all. A considerable portion of the southeast of the empire is occupied by members of the Rumanian (or eastern Romanic) stock, who number altogether about 2,800,000, and from more than half the population of Transylvania, besides being spread over the southeastern parts of Hungary, Bukowina and part of Croatia and Slavonia. The number of Jews is also very considerable (above 2,258,000), especially in Galicia, Hungary, Bohemia and Moravia. There are also several other races whose numbers are small, such as the Gypsies (95,000), who are most numerous in Hungary and Transylvania, and the Albanians in Dalmatia and neighboring regions. The population is thickest in lower Austria, Bohemia, Silesia and Moravia; thinnest in Salzburg. Generally speaking, it decreases in density from west to east.

Religion.— The state religion of Austria is the Roman Catholic, and next in numbers is the Greek Church. Calvinism and Lutheranism are also professed by a large body of the people; the former mostly in Hungary and Transylvania, the latter in the German provinces and in Galicia. The civil power exercises supreme control in all ecclesiastical matters, the Emperor being, in everything but name, head of the Church; and as no sentence of excommunication, or other ecclesiastical edict, can be issued without the sanction of the Crown, the Pope's direct authority in Austria is somewhat limited. In 1910 there were in the Austrian portion of the monarchy 22,530,169 Roman Catholics, 3,417,223 Greek Catholics united to the Roman Church, 666,458 non-united, 430,900 Protestants and 1,313,687 Jews. In Hungary and Transylvania there were 9,010,305 Roman Catholics, 2,007,916 Greek united and 2,333,979 non-united, 1,306,384 Protestants and 911,227 Jews.

Education.— The intellectual culture of the people is at very different stages of advancement among the different races. It is highest in the German provinces and lowest in the east. In Upper and Lower Austria, Salzburg, Tyrol, Moravia, Silesia and Bohemia, almost all the children of suitable age are in attendance on the public schools; while in Bukowina only about 34, and in Galicia about 59, per cent of them are at the schools. The educational system has been entirely remodeled. The elementary schools, or those in which the common branches are taught, are designated national schools or schools for the people (*Volksschulen*), and there children have to attend from the end of their 6th to the end of their 14th (in some provinces only their 12th) year. A higher class of elementary schools are known as town schools (*Bürgerschulen*), in which a superior education may be obtained. For the training of instructors for the people's schools, there are 43 normal schools for male teachers and 26 for female. As secondary schools or institutions of a more advanced grade, there are the gymnasia and the "real-schools," as they are called. The gymnasia resemble the best sort of our grammar schools, being intended chiefly to prepare pupils for the universities, great attention being paid in them to the classical languages and history, universal and literary. In the real-schools a more practical end is kept in view, and modern languages and physical science form the groundwork of the educational course. A complete course in a gymnasium extends over four years, in a real-school either three or four. There are also schools of an intermediate stamp known as "real-gymnasia." The higher education is provided for by the universities, the polytechnic institutes and the various institutions in which particular subjects are taught. There are 11 universities in the monarchy, namely, in Vienna, Prague (two — a German and a Bohemian), Pesth, Gratz, Cracow, Lemberg, Innsbruck, Klausenburg, Agram and Czernowitz. Most of these have four faculties — Catholic theology, law and politics, medicine and philosophy. There are also several technical high schools in which mathematics, physics and natural science are the chief objects of study. Besides these there are theological institutions; schools for jurisprudence and philosophy; schools of commerce, industrial arts, agriculture, arboriculture and mining; military schools, naval schools, art schools, conservatories of music, etc. The principal libraries are the royal library at Vienna, and the university libraries of Vienna and Prague.

Constitution, Revenue.— As already mentioned, the Austrian dominions consist of a German or Slavo-Germanic or Cisleithan empire, and a Transleithan or Hungarian kingdom, each with its own Parliament, ministers and government as established by the Pragmatic Sanction of 6 Dec. 1724. The same hereditary sovereign rules over both, and they have a common army and navy, and a common Parliament known as the Delegations. The Delegations consist of 120 members, one-half of whom are chosen by and represent the legislature of German-Austria, and the other half that of Hungary, the upper house of each legislature returning 20 and the lower house 40 deputies. In all matters affecting the common affairs of the monarchy the Delegations have a decisive vote, and their resolutions do not require the confirmation of the representative assemblies in which they have their source. The Delegations meet alternately in Vienna and Budapest. Their ordinary mode of procedure is to sit and vote in two chambers, the 60 deputies of Cisleithan Austria forming the one, and the 60 of Hungary the other. But if no agreement can be arrived at in this manner, the two bodies must meet together and without further debate give their final vote, which is binding for the whole empire. The jurisdiction of the Delegations extends specially to all matters affecting foreign affairs, war and finance. The Constitution of German-Austria was finally established in December 1867. The provinces have each a diet or legislature of their own for provincial affairs, these diets being 16 in number, one each for Bohemia, Dalmatia, Galicia, Upper Austria, Lower Austria, Salzburg, Styria, Carinthia, Carniola, Bukowina, Moravia, Silesia, Tyrol, Vorarlberg, Görz and Gradisca and Istria, the municipal council of Trieste having similar functions. The provincial diets are composed of the archbishops and bishops, the rectors of the universities, the representatives of the great estates, of towns, of boards of commerce, of rural communes, etc. The laws passed in these diets have reference

to provincial taxation, agricultural, educational and other matters. The national Parliament or legislature of German-Austria, called the *Reichsrath* (or council of the realm), consists of an upper house or House of Lords (*Herrnhaus*), and a lower house or House of Deputies (*Abgeordnetenhaus*). The former is composed of princes of the Imperial family, of nobles whose families have a hereditary right to this dignity, of the archbishops, the bishops of princely rank, and of a certain number of life members nominated by the Emperor. The lower houses consist of 353 members, elected by all citizens above 24 possessing a small property qualification. The rights belonging to the Reichsrath are: consent to all laws relating to military service; co-operation in the legislation on commercial matters, customs, railways, etc.; and examination of the estimates of the income and expenditure of the state, and other financial matters. The Constitution of Hungary, including also Croatia, Slavonia and Transylvania, dates from the foundation of the kingdom, or about 895 A.D. It rests upon a number of statutes published at long intervals, the principal of these being the *Bulla Aurea* or Golden Bull of Andrew II, granted in 1222, by which the government was defined as an aristocratic monarchy. The legislative power is vested in the King and the Parliament (*Reichstag*) conjointly. The latter consists of an upper house or House of Magnates, and of a lower house or House of Representatives. The House of Magnates consists of the archdukes of the Imperial family who have attained their majority, 54 ecclesiastical dignitaries, 151 counts and 36 barons as hereditary members, 84 life members nominated by the sovereign, or elected by the chamber, etc. The lower house (of 453 members) is composed of elected representatives. The Hungarian Reichstag corresponds to the Reichsrath of the Cisleithan provinces, and accordingly only deals with such matters as are common to the provinces belonging to the Hungarian Crown. Transylvania is, so far as legislation and administration are concerned, entirely incorporated with Hungary. Croatia and Slavonia, however, have a Landtag or diet of their own, which like the provincial diets of the Cisleithan portion of the empire, consists of only one chamber, and which is competent to deal with all matters belonging to the interior administration of the provinces, with religion and education, and with the administration of justice. Fiume, which was formerly associated with Croatia and Slavonia, and subject to the Landtag of these provinces, in August 1870, was put directly under the central Hungarian government.

There being three distinct parliaments in the empire, there are also three budgets, namely, that for the whole empire, that for Cisleithan and that for Transleithan Austria. In the budget for 1910 the revenue of Austria was $599,098,400; of Hungary $414,909,800; the expenditure of Austria was $580,272,800; of Hungary $380,333,200. A small portion of the imperial revenue of Austria is derived from customs and other sources, and the remainder is made up by the two divisions of the empire, 70 per cent thereof being contributed by Austria and 30 per cent by Hungary.

Recent Politics.— Austria to-day is, what Metternich with less truth called Italy, little more than a geographical expression. Three bonds unite its discordant nationalities. There is nothing really Austrian in Austria — no Austrian interests, no Austrian language, or literature, or patriotism, no Austrian nationality, no Austrian standard of civilization; nothing except the Emperor, and the army, and the forum of the Reichsrath that the races share in common. The Germans form a compact entity by themselves in Upper and Lower Austria and the duchy of Salzburg. In Bohemia there is a considerable colony along the borders of Saxony and Bavaria, over 2,000,000 strong, but even so they are outnumbered by the Czechs in the ratio of 3 to 5. All together the German-speaking subjects are about a third of the total population of Austria — some 10,750,000 out of 28,572,000. The Czechs in Bohemia, Moravia and Silesia number roughly 5,000,000. In Galicia some 4,000,000 Poles hold down a trifle over 3,000,000 Ruthenians. The Serbs, Croats and the Slovenians, known under the collective name of *Jugoslavs* (i.e., South Slavs), number roughly 6,000,000 and constitute the bulk of population of the provinces of Bosnia, Herzegovina, Dalmatia and the Dalmatian archipelago, Croatia and Slavonia, including Dricka (Fiume) and the Merjumurje, Baranja, Backa, Banat, Istriu, the Quarnero Isles, Carniola, Gorica, southern Carinthia, southern Styria and some districts of the southwestern Hungary, while nearly 1,000,000 Italians inhabit the Tyrol. None of these races can alone be said to represent Austria, though all of them claim to; and their mutual wranglings, struggles to realize themselves, struggles to elbow out their neighbors and seize an incontestable ascendency, are the background, and at times something more, of modern Austrian politics. But for the dashing tenacity of the Magyars, Hungary might be as heterogeneous as her partner in the dual monarchy. The Magyars are only 7,500,000 out of nearly 20,886,500, but they are a race with the fierce hardihood and determination of the Teutonic stock and a grace and fascination that are neither Latin nor Celtic, but distinctively their own. Since the two nations entered into a partnership agreement as coequal and sovereign states, the Magyars have devoted all their brilliant energies and the immense force of a concentrated one-idealness to making themselves paramount throughout the southern half of the realm. They revolted against being Germanized, but see no inconsistency in insisting that the Serbians, Croats, Rumanians and Slovenes shall be Magyarized; and they pursue the task with unsparing persistency just saved from relentlessness by their genius for wise compromise. The schools have been a much more effective instrument in the development of a national feeling, and the Magyars have thoroughly worked them to that end. Like the Russians and Americans, but unlike the English, the Magyars recognize that where there is difference of speech there will be difference of sentiment, of heart, of interests, and at a pinch perhaps of loyalty, and have accordingly refused to make the preservation of dialects an object of government. Fifty years ago the Hungarian nobles spoke German and a bastard monkish Latin in their homes and diets. To-day the native tongue obtains, among all classes, and the absorption of all manner of outlanders,— German, Slovacks, Jews, Rumanians and Croats,

by the irresistible and peaceful process of denationalization in the schoolroom, has gone on at such a pace that the Magyars increase nearly three times as quickly as any of the neighboring races. The struggle of the nationalities in Hungary has ended in a more or less resigned acquiescence in Magyar rule.

In Austria, as in Spain, the factory is placed some distance behind the barracks as an element of national welfare, and a contemptuous bureaucracy shackles trade with a hundred entangling regulations. The Magyars, on the other hand, have been as attentive to commerce as to their racial position. Perhaps there is no country in which the state, as such, has done more for industrial development. The really vital domestic problems of Hungary are, indeed, no longer racial, and as freedom of worship is the law, they have never been acutely religious. But in the rise of what is called Agrarian Socialism there is something that may test Magyar statesmanship severely. Meanwhile the Magyars are the backbone of the dual monarchy. Against the rising tides of Pan-Slavism they present a compact and unbending front. Together with the German empire they may be considered the outposts of Europe against Slav aggression; and even in the domestic affairs of the monarchy their unbreakable unity as a political force has made their influence well-nigh decisive. The *Ausgleich* of 1867, —the partnership agreement between the two halves of the realm,—prescribed that matters of common concern, such as foreign affairs, diplomatic representation and naval and military matters, should be arranged by 60 delegates from each country, meeting twice a year. The Austrian delegation is made up of Germans, Czechs, Poles, Ruthenians, Italians, whose feuds make steady co-operation all but impossible. The Hungarian delegation, on the other hand, is composed of 55 Magyars and five Croatians, working with the directness and harmony of a single man. The consequence is that in the long run the Hungarian view is fairly sure to carry the day. So far each renewal of the *Ausgleich* has brought substantial modifications in favor of Hungary, and the centre of gravity has, in fact, shifted from Vienna to Budapest. The Emperor, when driven to it, might go against the German-speaking Austrians, but never against the Magyars; and the Magyars, fully realizing their power, have extorted concession after concession from their unhappy partner; have applied the screw so persistently that it is becoming a question whether they are not as unpopular among Austrian statesmen as the very Czechs themselves. The troubles of the dual monarchy are due to the failure of the Germans to repeat in Austria the successes of the Magyars in Hungary. "You look after your hordes," said Count Beust to a Hungarian statesman when the Austrian empire became the dual monarchy, "and we'll look after ours." The Czechs of Bohemia have turned to ridicule the count's too valiant declaration. The Germans of Vienna, one must remember, are very different from the Germans of Berlin. Of all the sections of the Teutonic race they appear to have the least robustness of intellect or character and the laxest grip on practical affairs. Indolent, hypercritical and self-satisfied, they are emasculated editions of their northern kinsmen. From whatever cause, some paralyzing blight of lassitude and ineffectiveness seems to have eaten its way into their energies. Against their cultured fecklessness the Czechs oppose the elemental force of racial ambition, the driving power of a people that has the consciousness of a great destiny before it and feels itself on the top of the rising wave.

The Germans protest that they have educated themselves beyond the point where race is everything and cannot at this time of day be expected to return to first principles. It is of course tenable that the variety of parties into which the Germans are split up argues an advanced and broad political intelligence. At the same time it makes a poor barrier against the impact of a race that subordinates everything to a single practical end; and unless the Germans are prepared to see a great part of their old ascendency pass away, they must be ready to drop "theorizing," take up the issue that has been forced upon them and meet their antagonists with weapons not necessarily of their own choosing. In other words, they need simplifying if they are to combat the Czechs successfully. As it is, the Czechs for the last 50 years have been slowly driving them to the wall. City after city has fallen into their hands; Prague and Pilsen, that only a quarter of a century ago were German in tongue and sentiment, are now Slavonized down to their very street names. And in politics and industry as well as music and literature and the lighter arts, the past hundred years have seen the Czechs advance in a quite wonderful fashion. They have long ceased to fear the Germans, and with the disappearance of fear comes naturally the claim to equality. Moreover, the Czechs have a strong historical case. Four hundred years ago what are now the Crown-lands of Bohemia, Moravia and Silesia formed the Czech kingdom of Saint Vacslav; and what is now Hungary was then the kingdom of Saint Stephen. The Czechs offered their crown in 1526 to the Hapsburgs, at the same time, for the same reasons and on the same conditions as the Magyars; stipulating only that they should retain their old rights of self-government. This contract, together with the Pragmatic Sanction, was the legal basis of the Hungarian rebellion of 1848. The Czechs still use it to point the justice of their demands for a resurrection of Saint Vacslav's kingdom, maintaining that their case is on all fours with that of Hungary, rests on the same documents and is supported by the same coronation oaths. The Hapsburgs never quite lived up to their side of the agreement. They allowed the Turks to overrun Hungary at will, and when the Reformation came and the Czechs gathered round John Huss, they stamped out the heresy in blood and established a strong German colony along the northern borders of Bohemia for the protection of the faith and the suppression of the natives. The Czechs have kept their native tongue alive, and just across their borders are their kinsmen of the Russian empire. The card of Russian sympathy is often played, and after every fresh frustration of their national hopes follows the spectacle of 5,500,000 Czechs cautiously sounding the Tsar's "racial instinct." It is this that lends color to the common charge that the Czechs are disloyal, but it is to be noticed that when the situation is reversed and the Emperor makes even the

shortest step toward Home Rule, the Germans at once adopt their opponents' tactics, throw themselves into the arms of their Prussian brethren, and vow that sooner than stay and be swamped by a hated and inferior race, they would willingly exchange the Hapsburgs for the Hohenzollerns and enroll themselves among Kaiser Wilhelm's subjects. The suspicion cannot be avoided that these dramatics are at bottom intended for home consumption and that the tune would be quickly changed if the Tsar or Kaiser were to listen too seriously.

The whole history of the dual monarchy goes to show that real consolidation and unity can be effected only by the seemingly paradoxical method of allowing each nationality the widest possible freedom. Justice toward and equal treatment of all races is the only sure road to peace and permanency. It is a hard one for the Germans to tread, for it means the overthrow of an ascendency once paramount in every corner of the realm; but unless universal suffrage brings to the front an entirely new set of problems, trod it must be. The interplay of these racial ambitions has been complicated, sometimes retarded and sometimes acutely emphasized by a hundred differences of religious, economic and purely political interests, all of which have representatives in the Reichsrath. They act upon one another under the shadow of the racial issues in a way that no foreigner can disentangle. The confusion of the country is worthily reproduced in the 15 distinct parties and the seven or eight languages that crop up in the Vienna Parliament. Austria-Hungary is a polyglot chaos in which even Austrians do not profess to see more than a half light. The prophecies of disruption may therefore appear at least plausible. But it is one of the many paradoxes of the dual monarchy that it seems unable to break up. In part it is protected by the very diversity and number of the antagonisms it is obliged to house. A more visible bond of union is the army, in which all must serve, which is of all races and creeds, and therefore of none, and the atmosphere of which is broadly and impressively imperial. What its actual effectiveness will prove to be like, should it ever be tested, is one of the most interesting military problems of the day. The only force with which it can be compared in the excellence of its units and the variety of its nationalities and tongues is the allied army that rescued the Pekin legations; and the parallel is not altogether hopeful. A polyglot army must of necessity be to some extent a disorganized army, and while the forces of the dual monarchy use German as the language of military command, the rank and file and the bulk of the officers retain their own speech for general purposes. The heterogeneous character of its composition has had a steadying influence on the internal struggles of the dual monarchy, however much it may hamper its efficiency on the battlefield. The army has kept itself largely aloof from politics, and though the Czechs did once attempt to transfer the racial bitterness to the parade ground by answering the roll-call in their own tongue, a sharp rebuke from the Emperor was enough to bring them to reason.

A second and equally powerful bond of union has been the monarchy. Not only is it accepted everywhere, but the idea of upsetting it in favor of any other form of government has never yet been broached. Even the irreconcilables, who would like to see the *Ausgleich* abolished and Hungary direct her own fiscal policy,—a quite possible development,—and manage her own foreign affairs, still do not propose to sever the personal tie that binds the two countries. And not only is the monarchy secure in the affections of the people, but the dynasty is equally popular. So long as there is a throne it is not conceivable that any one but a Hapsburg should occupy it. This two-fold devotion to monarchy and to the dynasty was greatly strengthened, partly by the breakdown of parliamentary government and weariness which made the people look to the throne as an escape from the turmoil and wranglings of small groups, and partly through the patience and wisdom, the sterling fairness and competency of the late Emperor Francis Joseph, as well as the ghastly tragedies of his private life. What the Czechs and the other races want, is the same independence as the Magyars possess, but such independence is as inconsistent with Russian as with German domination. It is against their interests to break away from the Hapsburgs.

Army.— Military service is obligatory on all citizens capable of bearing arms who have attained the age of 20, and lasts up to the age of 42, either in the active army, in the landwehr or the landsturm. The period of service in the active army is 12 years, of which three are passed in the line, seven in the reserve and two in the landwehr. In 1914 the standing army numbered 430,417 men (including 32,398 officers) on the peace footing, and 1,826,940 men and 45,238 officers on the war footing. The landsturm raises the total to over 6,000,000.

Navy.— On account of the development of the Italian navy, Austria found it necessary for her self-defense to have a fleet of her own. Besides a flotilla of monitors for the Danube, the Austrian navy, in 1914, comprised 4 dreadnoughts, 12 pre-dreadnoughts, 3 armored cruisers, 9 cruisers and torpedo-cruisers, 3 torpedo gunboats, 18 destroyers, 63 torpedo boats and 11 submarines.

Judiciary.— The courts of first instance comprise 940 *Bezirksgerichte,* County Courts, and 71 *Landes und Kreisgerichte,* Provincial and District Courts; *Geschworenengerichte,* or Jury Courts, being connected with the latter. These courts act as courts of inquiry and have summary jurisdiction. The courts of second instance, or courts of appeal from the lower courts, having the supervision of the criminal courts, comprise nine *Oberlandesgerichte,* or higher provincial courts. There are also special tribunals for military, revenue, shipping and other matters, including four industrial courts and three commercial courts. The *Oberste Gerichts und Kassationshof,* Supreme Court of Justice and Court of Cassation at Vienna, is the final court of appeal. The High Court of Administrative Affairs decides differences between private individuals and public officials, and the Reichsgericht, or Court of the Empire, the conflicts of law and jurisdiction between different authorities.

History of the Country till the Year 982. —After the Romans had vanquished the Noricans, 33 A.D., and gained possession of the Danube, the country north of the Danube, extending to the borders of Bohemia and Moravia, be-

longed to the kingdom of the Marcomanni and Quadi; a part of lower Austria and Styria, with Vienna (Vindobona), a municipal city of the Roman empire, belonged to upper Pannonia; the rest of the country, with Carinthia and a part of Carniola, formed a portion of Noricum. Görz belonged to the Roman province of Illyricum, and Tyrol to Rhætia. These limits became confused by the irruptions of the West-Goths, who spread over the upper Pannonia and Noricum but recognized the Roman supremacy as early as 380 A.D. The Boii, Vandals, Heruli, Rugii, Goths, Huns, Lombards and Avars, in the course of the 5th and 6th centuries, successively occupied the country. But after the year 568, when the Lombards had established their power in upper Italy, the river Ens formed the boundary line between the German tribe of Bajuvarii, the proprietors of the territory above the Ens, and the Avars, who had removed from the east to the banks of that stream. In 611 the Wendi, a Slavonic tribe, appeared on the Murr, Drave and Save. In 788 the duchy of Bavaria was dissolved, and the Avars passed over the Ens and invaded the counties of the Franks in the Bavarian territory. In 791 Charlemagne forced them to retire to the Raab, and united the territory extending from the Ens to the junction of the Raab with the Danube (the territory below the Ens) with Germany, under the name of Avaria, or the Eastern Mark (Marchia Orientalis), or Austria; and in the 10th century (in a document of Otho III 996) it was called Ostirrichi, equivalent to the modern Oesterreich. Many colonists, particularly from Bavaria, were sent by Charlemagne into the new province, and a margrave was appointed to administer the government. The archbishop of Salzburg was at the head of ecclesiastical affairs. After its separation from Verdun, in 843, Avaria formed the east boundary of the German empire. On the invasion of Germany by the Hungarians, in 900, Avaria fell into their hands, and was held by them till 955, when the Emperor Otho I, in consequence of the victory of Augsburg, reunited a great part of this province to the empire. By the power and address of its margraves the whole country was joined again with Germany, and in 1043, under the Emperor Henry III and the Margrave Albert I (the Victorious), its limits were extended to the Leitha.

Austria under the House of Bamberg till 1282.—Otho II transferred in 976 the Austrian margraviate to his faithful adherent Leopold I, who was, according to tradition, a descendant of the house of Count Adelbert Badenburg, who became famous by his victories over the Madyors, and perished in 994. From that year to 1156 the margraviate of Austria was hereditary in the family of the counts of Badenburg (Bamberg); the succession, however, was not regulated by primogeniture, but by the will of the Emperor. In ancient documents mention is made of the estates of Austria in the year 1096. After Henry the Proud (Duke of Bavaria and Saxony) was put under the ban of the empire, Leopold V, Margrave of Austria, received the duchy of Bavaria in 1138 from the Emperor Conrad. But when the Margrave Henry, son of Leopold, under the title of *Ja-so-mir-Gott* (Yes-so-me-God), had again ceded it, in 1156, to Henry the Lion, the boundaries of Austria were extended so as to include the territory above the Ens, and the whole was created a duchy with certain privileges. Under this duke the court resided at Vienna. Duke Leopold VI, the son of Henry, received the duchy of Styria in 1192 as a fief from the Emperor Henry VI, it having been added to the empire by Otho I, in 955, by his victory over the Hungarians. It was this prince who imprisoned Richard Cœur de Lion, King of England. Duke Leopold VII, the youngest son of the former, erected a palace within the city of Vienna, which was long occupied by the Austrian monarchs, under the name of the old castle. Leopold VII, called the Glorious, established the hospital of the Holy Cross, made Vienna, which had adopted a municipal constitution in 1198, a staple town, and granted 30,000 marks of silver for the promotion of trade and commerce. In 1229 he purchased a part of Carniola from the ecclesiastical principality of Freisingen for 1,650 marks, and left the country in a flourishing condition to the youngest of his three sons, Frederick II, surnamed the Warrior. In 1236 this prince was put under the ban of the empire, on account of his joining the alliance of the cities of Lombardy against the Emperor Frederick II; and Otho, Duke of Bavaria, seized upon his territory above the Ens as far as Lintz. The rest of the country was granted, as a fief by the Emperor to a margrave, and Vienna became an imperial city.

During the Emperor's campaign in Italy Duke Frederick recovered the principal part of his lands, and his rights were confirmed by the Emperor at Verona, 1245. The rights of Vienna as an imperial city were abolished, and Frederick was to be called king, as sovereign of Austria and Styria; but all his expectations of empire were disappointed by his death in the battle of the Leitha against Bela IV, King of Hungary, 15 July 1246, in the 35th year of his age. Thus the male line of the house of Bamberg became extinct. The period from 1246 to 1282 is styled the Austrian interregnum. The Emperor Frederick II declared Austria and Styria a vacant fief, the hereditary property of the German emperors, and sent a governor to Vienna, the privileges of which, as an imperial city, were once more renewed. But the female relations of the deceased Duke Frederick, his sister Margaret (widow of the Emperor Henry VI), and his niece Gertrude, by the persuasion of Pope Innocent IV, in 1248, laid claim to the inheritance of their brother. The Margrave Hermann, with the aid of the Pope and a strong party, made himself master of Vienna, and of several Austrian cities. In Styria he was opposed by the governor Meinhard, Count of Görz. But Hermann died in 1250, and his son Frederick, who was afterward beheaded in 1268, at Naples, with Conradin of Suabia, was then only a year old. The whole country was distracted by various parties, and the Emperor Conrad IV was prevented, by disputes with his neighbors, from turning his attention to Austria. In 1251 the states of Austria and Styria determined to appoint one of the sons of the second sister of Frederick the Warrior, Constantia (widow of the Margrave Henry the Illustrious), to the office of duke. The deputies were on the way to Misnia when they were persuaded by King Wenceslaus, on their entrance into Prague, to declare his son Ottocar

Duke of Austria and Styria, who made every effort to support his appointment by arms, money, and especially by his marriage with the Empress widow Margaret. Ottocar wrested Styria from Bela, King of Hungary, by his victory of July 1260, in the Marchfield; and in 1262 forced the Emperor Richard to invest him with both duchies. Soon after, by the will of his uncle Ulrich, the last Duke of Carinthia and Friuli (who died 1296), Ottocar became master of Carinthia, a part of Carniola connected with it, the kingdom of Istria and a part of Friuli. But his arrogance soon caused his fall. In 1272 he refused to acknowledge Count Rudolph of Hapsburg emperor, and was obliged to defend himself against Rudolph. After an unsuccessful war he was forced to cede all of his Austrian possessions in November 1276. In 1277 he attempted to recover these territories, but, in the battle of the Marchfield, 26 Aug. 1278, he was slain, and his son Wenceslaus was obliged to renounce all claim to them, in order to preserve his hereditary estates. The Emperor Rudolph remained three years in Vienna, and then appointed his eldest son Albert governor. But having succeeded in gaining the consent of the Electors of Saxony and Brandenburg, of the three ecclesiastical electors and of the Count-Palatine of the Rhine, he granted the duchies of Austria and Styria, with the province of Carinthia, to his two sons, Albert and Rodolph, 27 Dec. 1280.

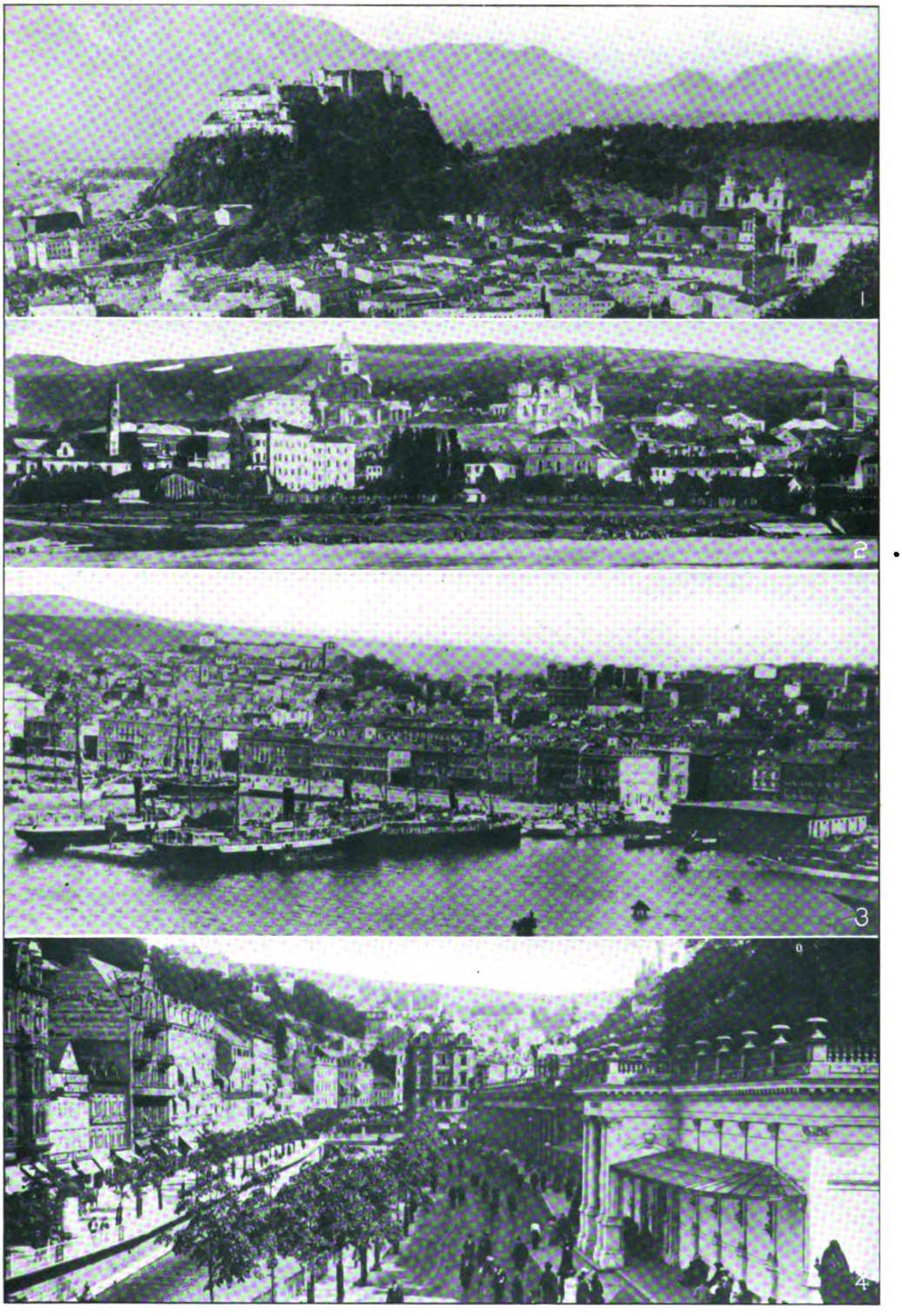
Austria under the House of Hapsburg.—I. From 1282 to 1526. Albert and Rodolph transferred Carinthia to Meinhard, Count of Tyrol, father-in-law to Albert. In 1283 they concluded a treaty, by which Albert was made sole possessor of Austria, Styria and Carniola. Vienna having again renounced its privileges as an Imperial city, was made the residence of the court, and the successors of Rodolph, from this time, assumed Austria as the family title. The introduction of the Hapsburg dynasty was the foundation of the future greatness of Austria. The despotic Albert was assailed by Hungary and Bavaria and in 1298 he won the Roman crown in an engagement with Adolphus of Nassau. After this he undertook the conquest of Switzerland; but was assassinated 1 May 1308, at Rheinfelden, by his nephew, John of Suabia, from whom he had basely withheld his hereditary estates. The inheritance of John now fell to the five sons of the murdered Albert — Frederick, surnamed the Fair, Leopold, Henry, Albert and Otho. They were forced to purchase of the Emperor Henry VII the investiture of their paternal estates (consisting, in 1308, of 26,572 square miles) for 20,000 marks of silver. Under their father, in 1301, the margraviate of Suabia was added to the territories of Austria, and the contest with Bavaria ended in Austria obtaining Neuberg. On the contrary, the attempt of Duke Leopold, in 1315, to recover the forest towns of Switzerland, which had been lost under Albert, was frustrated by the valor of the troops of the Swiss confederacy in the battle of Morgarten. In 1314 his brother Frederick, chosen Emperor of Germany by the electors, was conquered by his rival, the Emperor Louis (of Bavaria), in 1322, at Mühldorf, and was his prisoner for two years and a half in the castle of Trausnitz. The dispute with the house of Luxemberg, in Bohemia, and with Pope John XXII induced the Emperor, in 1325, to liberate his captive. Upon this the latter renounced all share in the government, and pledged himself to surrender all the Imperial domains which were still in the possession of Austria. But Leopold considered the agreement derogatory to his dignity and continued the war against Louis. Frederick, therefore, again surrendered himself a prisoner in Munich. Moved by his faithful adherence to his word, Louis concluded a friendly compact with Frederick, and made preparations for their common government, 7 Sept. 1325. These preparations, however, were never carried into execution; for the agreement had been concluded without the consent of the electors. Leopold died in 1326, and Henry of Austria in 1327; Frederick also died without children, 13 Jan. 1330, after which his brothers, Albert II and Otho, came to a reconciliation with the Emperor Louis. After the death of their uncle, Henry, Margrave of Tyrol and Duke of Carinthia (the father of Margaret Maultasch), they persuaded the Emperor to grant them the investiture of Tyrol and Carinthia, in May 1335; they ceded Tyrol, however, to John, King of Bohemia, by the treaty of 9 Oct. 1356, in behalf of his son John Henry, or rather of his wife, Margaret Maultasch. In 1344, after the death of Otho and his sons, Albert II, called the Wise, united all his Austrian territories, which, by his marriage with the daughter of the last Count of Pfirt, had been augmented by the estates of her father in 1324, and by the Kyburg estates in Burgundy in 1326. Of the four sons of Albert II (Rodolph, Albert, Leopold and Frederick), Rodolph II (IV) completed the church of Saint Stephen's and laid the foundation of the University of Vienna. He died in Milan in 1365, without children, a short time after his youngest brother, Frederick. In 1379 the two surviving brothers divided the kingdom, so that Albert III (with the Queue) became master of Austria, and gave the other territories to his brother, Leopold III, the Pious. Leopold had made repeated attempts to gain the Hapsburg possessions in Switzerland and extended the territory of his realm to a considerable degree, having purchased, among other minor provinces, the county of Feldkirche, Bludenz, Hohenberg, upper and lower Suabia and, 1382, Trieste. He was killed 9 July 1386, on the field of Sempach, where he lost the battle, in consequence of the valor of Winkelried, and Albert administered the government of the estates of his brother's minor sons. Margaret Maultasch ceded Tyrol to him on the death of Meinhard, her only son, who was married to the sister of Albert. She retained nothing but a few castles and 6,000 marks of gold. Her claims to Bavaria also she renounced in consideration of receiving Scharding and three Tyrolese cities, Kitzbühel, Ballenberg and Kuffstein, and 116,000 florins of gold. In 1365 Leopold III had bought the claims of the Count of Feldkirch for 36,000 florins; for 55,000 florins Austria received Brisgau from the Count of Fürstenberg, with the cities of Neuberg, Old Brisach, Kentzingen and Billingen. The remainder of Carniola and the Windisch Mark, after the death of the last Count of Görz, were purchased, together with the county of Pludentz, from the Count of Werdenberg, and the possessions of the Count of Hogenberg, for 66,000 florins; and the city of

Trieste was acquired in 1380 by aiding in the war between Hungary and Venice. Moreover, the two governments of upper and lower Suabia were pledged for 40,000 florins by the King of Rome, Wenceslaus, to Duke Leopold. The Austrian and Styrian lines, founded by Albert III and Leopold III, his brother, continued for 78 years. In 1395, when Albert III died, his only son, Albert IV, was in Palestine. On his return he determined to take vengeance on Procopius, Margrave of Moravia, for his hostile conduct; but he was poisoned in 1404 at Znaym. His young son and successor, Albert V, was declared of age in 1410; and being the son-in-law of the Emperor Sigismund, he united the crowns of Hungary and Bohemia in 1437, and connected them with that of Germany in 1438. But in the following year the young prince died. His posthumous son, Ladislaus, was the last of the Austrian line of Albert, and its possessions devolved on the Styrian line, 1457.

From this time the house of Austria has furnished an unbroken succession of German emperors. Hungary and Bohemia were lost for a time by the death of Albert V, and, after the unhappy contests with the Swiss, under Frederick III, the remains of the Hapsburg estates in Switzerland. But several territories were gained; and, to increase the rising splendor of the family, the Emperor conferred upon the country the rank of an archduchy. The dispute which broke out between Frederick and his brothers Albert and Sigismund, relating to the divisions of their paternal inheritance, ended with the death of Albert in December 1464. In the course of the troubles which resulted from this quarrel the Emperor was besieged in the citadel of Vienna by the citizens, who favored the cause of the murdered prince. Sigismund now succeeded to his portion of the estate of Ladislaus and Frederick became sole ruler of all Austria. His son Maximilian, by his marriage with Mary, the surviving daughter of Charles the Bold, united the Netherlands to the Austrian dominions. But it cost Maximilian much anxiety and toil to maintain his power in this new province, which he administered as the guardian of his son Philip. After the death of his father, 19 Aug. 1493, he was made Emperor of Germany, and transferred to his son Philip the government of the Netherlands. Maximilian I added to his paternal inheritance all Tyrol, and several other territories, particularly some belonging to Bavaria. He also acquired for his family new claims to Hungary and Bohemia. During his reign Vienna became the great metropolis of the arts and sciences in the German empire. The marriage of his son Philip to Joanna of Spain raised the house of Hapsburg to the throne of Spain and the Indies. But Philip died in 1506, 13 years before his father, and the death of Maximilian, which happened 12 Jan. 1519, was followed by the union of Spain and Austria; his grandson (the eldest son of Philip), Charles I, King of Spain (see CHARLES V), was elected Emperor of Germany. In the Treaty of Worms, 28 April 1521, and of Ghent, 7 May 1540, he ceded to his brother Ferdinand all his hereditary estates in Germany, and retained for himself the kingdom of the Netherlands. The house of Austria was now the proprietor of a tract of country in Europe comprising 360,230 square miles. The Emperor Charles V immediately increased the number of provinces in the Netherlands to 17, and confirmed their union with the German states, which had been concluded by his grandfather, under the title of the circle of Burgundy. In 1526 Austria was recognized as a European monarchy.

II. From 1526 to 1740. Ferdinand I, by his marriage with Anna, the sister of Louis II, King of Hungary, who was killed in 1526 in the battle of Mohacs, acquired the kingdoms of Hungary and Bohemia, with Moravia, Silesia and Lusatia, the appendages of Bohemia. Bohemia rejoiced to hail Ferdinand its King. Notwithstanding the divided opinions of the nobles, and the rising fortune of his adversary, John von Zapolya (see HUNGARY), he was raised to the throne of Hungary 26 Nov. 1526, by the Hungarian Diet, and was crowned 5 Nov. 1527. But Zapolya resorted for assistance to the Sultan, Soliman II, who appeared in 1529 at the gates of Vienna. The capital was rescued from ruin solely by the Count of Salem, general of the Austrian army, and the Imperial forces compelled Soliman to retreat. In 1535 a treaty was made by which John von Zapolya was allowed to retain the royal title and half of Hungary, and his posterity were to be entitled to nothing but Transylvania. But after the death of John new disputes arose, in which Soliman was again involved, and Ferdinand maintained the possession of lower Hungary only by paying the warlike Sultan the sum of 30,000 ducats annually. This took place in 1562. Ferdinand was equally unsuccessful in the duchy of Würtemberg. This province had been taken from the restless Duke Ulrich by the Suabian confederacy, and sold to the Emperor Charles V; and when his estates were divided it fell to Ferdinand. Philip, Landgrave of Hesse, the friend of Duke Ulrich, took advantage of the opportunity offered him by the embarrassment of Ferdinand in the Hungarian War. With the aid of France he conquered Würtemberg; but France ceded it again to Ulrich in the Treaty of Baden, in Bohemia, concluded 20 June 1534 on condition that the province should still be a fief of Austria, and after the extinction of the male line of the Duke that it should revert to that country. Ferdinand received also the Imperial crown in 1556, when his brother Charles laid by the sceptre for a cowl. He died 25 July 1564, with the fame of an able prince, leaving three sons and 10 daughters. According to the directions given in his will, the three brothers divided the patrimony, so that Maximilian II, the eldest son, who succeeded his father as Emperor, obtained Austria, Hungary and Bohemia; Ferdinand, the second son, received Tyrol and Hither Austria; and Charles, the third, became master of Styria, Carinthia, Carniola and Görz. But in 1595, after the death of the Archduke Ferdinand, the husband of Philippine Welser, the fair maid of Ausburg, his sons Andrew (cardinal and bishop of Constance and Brixen, and governor of the Netherlands for Spain) and Charles (Margrave of Burgau) were declared incompetent to succeed their father, and his possessions reverted to his relations. In Hungary the Emperor Maximilian met with far better fortune than his father had done. The death of Soliman at Szigeth in 1566 was followed by a peace, and in 1572 Maximilian crowned his eldest son, Rodolph, King of Hun-

AUSTRIA



1 Salzburg and its Castle Fortress (11th Century)
(Copyright by Underwood & Underwood, N. Y.)

2 Przemysl, Galicia
(Underwood & Underwood Photo.)

3 Trieste
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4 Karlsbad

gary; he was afterward crowned King of Bohemia, and was elected King of Rome. In his attempts to add the Polish crown to his Austrian dominions he was equally unsuccessful with his fourth son, Maximilian, who engaged in a similar enterprise after the decease of Stephen Bathori in 1587. Maximilian died 12 Oct. 1576, and Rodolph, the eldest of his five sons, succeeded to the Imperial throne. The most remarkable events by which his reign is distinguished are the war against Turkey and Transylvania, the persecutions of the Protestants, who were all driven from his dominions, and the circumstances which obliged him to cede Hungary in 1608, and Bohemia and his hereditary estates in Austria in 1611, to his brother Matthias. From this time we may date the successful exertions of the Austrian sovereigns to put down the restless spirit of the nation, and to keep the people in a state of abject submission. Matthias, who succeeded Maximilian on the Imperial throne, concluded a peace for 20 years with the Turks; but he was disturbed by the Bohemians, who took up arms in defense of their religious rights. Matthias died 20 March 1619, before the negotiations for a compromise were completed. The Bohemians refused to acknowledge his successor, Ferdinand II, and chose Frederick V, the head of the Protestant League, and elector of the palatinate, for their king. After the battle of Prague, 1620, Bohemia submitted to the authority of Ferdinand. He immediately applied himself to eradicate Protestantism out of Bohemia proper and Moravia. At the same time he deprived Bohemia of the right of choosing her king, and of her other privileges. He erected a Catholic court of reform, and thus led to the emigration of thousands of the inhabitants. This large exodus of inhabitants did much to retard the growth of Bohemia. In fact the religious wars waged upon Bohemian soil for so long a time, dating back to the first outbreaks of the Hussites, with the subsequent agitations and conflicts consequent upon the Reformation, long and seriously hampered that state's general development up to modern times. The Austrian states also favoring, in general, the Protestant religion, were compelled by Ferdinand to swear allegiance to him, and Lutheranism was strictly forbidden in all the Austrian dominions. The province of Hungary, which revolted under Bethlem Gabor, Prince of Transylvania, was, after a long struggle, subdued. This religious war dispeopled, impoverished and paralyzed the energies of the most fertile provinces of the house of Austria. During the reign of Ferdinand III, the successor of Ferdinand II (1637–57), Austria was constantly the theatre of war.

In the midst of these troubles Ferdinand ceded Lusatia to Saxony at the peace of Prague, concluded in 1635; and when the war was ended he ceded Alsace to France, at the peace of Westphalia in 1648. The Emperor Leopold I, son and successor of Ferdinand III, was victorious through the talents of his minister Eugene, in two wars with Turkey; and Vienna was delivered by John Sobieski and the Germans under Karl von Lotharingien from the attacks of Kara Mustapha in 1683. In 1687 he changed Hungary into a hereditary kingdom, and joined to it the territory of Transylvania, which had been governed by distinct princes. Thanks to the victories of Prince Eugene of Savoy, Leopold succeeded in concluding a permanent peace at Carlovitz in 1699. Moreover, he restored to Hungary the country lying between the Danube and the Theiss. It was now the chief aim of Leopold to secure to Charles, his second son, the inheritance of the Spanish monarchy, then in the hands of Charles II, King of Spain, who had no children; but his own indecision, and the policy of France, induced Charles II to appoint Philippe d'Anjou, the grandson of Louis XIV, his successor. Thus began the war of the Spanish Succession (see Succession Wars) in 1701. Leopold died 5 May 1705, before it was terminated. Emperor Joseph I, his successor and eldest son, continued the war, but died without children, 17 April 1711. His brother Charles, the destined King of Spain, immediately hastened from Barcelona to his hereditary states, to take upon him the administration of the government. He was elected emperor 24 December of the same year; but was obliged to accede to the peace of Utrecht, concluded by his allies at Rastadt and Baden in 1714. By this treaty Austria received the Netherlands, Milan, Mantua, Naples and Sardinia. In 1720 Sicily was given to Austria in exchange for Sardinia. The duchy of Mantua, occupied by Joseph in 1708, was now made an Austrian fief, because it had formed an alliance with France prejudicial to the interests of Germany. This monarchy now embraced 191,621 square miles. Its annual income was between 13,000,000 and 14,000,000 florins, and its army consisted of 130,000 men; but its power was weakened by new wars with Spain and France. In the peace concluded at Vienna 1735 and 1738, Charles VI was forced to cede Naples and Sicily to Don Carlos, the Infante of Spain, and to the King of Sardinia a part of Milan, for which he received only a part of Parma and Piacenza. In the next year, by the peace of Belgrade, he lost nearly all of the fruits of Eugene's victories, even the province of Temeswar; for he was obliged to transfer to the Porte, Belgrade, Servia and all the possessions of Austria in Wallachia and Bosnia. To all this Charles VI willingly acceded in order to secure the succession of his daughter, Maria Theresa, by the Pragmatic Sanction. This law of inheritance was passed 1713–19, and acknowledged one after another by all the European powers.

Austria under the House of Hapsburg-Lorraine.— By the death of Charles VI, 20 Oct. 1740, the male line of the Austrian house of Hapsburg became extinct; and Maria Theresa having married Stephen, Duke of Lorraine, ascended the Austrian throne. On every side her claims were disputed, and rival claims set up. A violent war began in which she had no protector but England. Frederick II of Prussia subdued Silesia; the Elector of Bavaria was crowned in Lintz and Prague, and in 1742 chosen emperor under the name of Charles VII. Hungary alone supported the Queen. But in the peace of Breslau, concluded 4 June 1742, she was obliged to cede to Prussia, Silesia and Glatz, with the exception of Teschen, Jagerndorf and Troppau. Frederick II, by assisting the party of Charles VII, soon renewed the war. But Charles died 20 Jan. 1745, and the husband of Theresa was crowned Emperor of Germany under the title of Francis I. A second treaty

of peace, concluded 25 Dec. 1745, confirmed to Frederick the possession of Silesia. By the peace of Aix-la-Chapelle, 18 Oct. 1748, Austria was obliged to cede the duchies of Parma, Piacenza and Guastalla to Philip, Infante of Spain, and several districts of Milan to Sardinia. The Austrian monarchy was now firmly established; and it was the first wish of Maria Theresa to recover Silesia. With this object in view she formed an alliance with France, Russia, Saxony and Sweden. This was the origin of the Seven Years' War; but, by the peace of Hubertsberg, 1763, Prussia retained Silesia, and Austria had sacrificed her blood and treasures in vain. The first paper money was now issued in Austria, called state obligations, and the Emperor Francis erected a bank to exchange them. After his death, 18 Aug. 1765, Joseph II, his eldest son, was appointed colleague with his mother in the government of his hereditary states, and elected Emperor of Germany. To prevent the extinction of the male line of her family Maria Theresa now established two collateral lines; the house of Tuscany, in her second son, Peter Leopold; and the house of Este, in the person of the Archduke Ferdinand. For these separations Maria Theresa indemnified the country by the confiscation of several cities, formerly pledged to Poland by Hungary, without paying the sum for which they stood pledged; by obtaining Galicia and Lodomera in the first profligate division of the kingdom of Poland in 1772; and by the capture of Bukowina, which was ceded by the Porte in 1777. In the peace of Teschen, 13 May 1779, Austria received Innviertel, and the vacant county of Hohenembs in Suabia, the county of Falkenstein, and the Suabian territories of Tettnang and Argen; and thus at the death of the Empress, 28 Nov. 1780, Austria contained 234,684 square miles; it had lost 16,366 square miles, and gained 34,301. The population was estimated at 24,000,000; but the public debt also had increased to 160,000,000 florins. The administration of the Empress was distinguished by substantial improvements in connection with government, agriculture, trade and commerce, the education of the people, the promotion of the arts and sciences and of religion. The foreign relations of the kingdom also, even those with the Roman court, were happily conducted by the talents of her minister, Kaunitz.

Her successor, Joseph II, was active and restless; impartial, but too often rash and violent. While a colleague with his mother in the government he diminished the expenses of the state, and introduced a new system in the payment of pensions and of officers. But after the death of his mother all his activity and talent as a sovereign was fully developed. As severe to the military as to the civil officers, he adhered, however, to liberal principles. The censorship of the press was reformed; the Protestants received full toleration, and the rights of citizenship; the Jews were treated with kindness; 900 convents and religious establishments were abolished, and even the visit of Pius VI made no alteration in Joseph's system of reformation. The system of education he subjected to revision and improvement; and he tried to foster manufactures by duties on foreign goods. But his zeal excited the opposition of the enemies of improvement. The low countries revolted, and his vexation probably led him to attempt the exchange of the Netherlands, under the title of the kingdom of Austria, for the palatinate of Bavaria under an elector. But the project was frustrated by the constancy and firmness of the next magnate, the Duke of Deux-Ponts, and by the German league concluded by Frederick II. Joseph was equally unsuccessful in the war of 1788 against the Porte. His exertions in the field destroyed his health; and grief at the rebellious disposition of his hereditary states accelerated his death, which happened 20 Feb. 1790. Joseph II was succeeded by his eldest brother, Leopold II. By his moderation and firmness he quelled the turbulent spirit of the Netherlands, and restored tranquillity to Hungary. The Treaty of Reichenbach with Prussia, 27 July 1790, and the Treaty of Sistova, 4 Aug. 1791, led to a peace with the Porte. The unhappy fate of his sister and her husband, Louis XVI of France, induced him to form an alliance with Prussia, but he died 1 March 1792, before the revolutionary war broke out. Soon after the accession of his son, Francis II, to the throne, and before he was elected German Emperor, France declared war against him as King of Hungary and Bohemia. In the first articles of peace, dated at Campo Formio, 17 Oct. 1797, Austria lost Lombardy and the Netherlands, and received as a compensation the largest part of the Venetian territory; two years previous, in 1795, in the third division of Poland, the Austrian dominions had been enlarged by the addition of west Galicia. In the beginning of the year 1799, the Emperor Francis, in alliance with Russia, renewed the war with France. But Napoleon extorted the peace of Lunéville, 9 Feb. 1801, and Francis acceded to it, without the consent of England. By the conditions of the treaty he was to cede the county of Falkenstein and the Frickthal. Ferdinand, Grand Duke of Tuscany, at the same time renounced his claim to this province and received in return for it Salzburg and Berchtesgaden, with a part of the territory of Passau, and was afterward made master of the largest part of Eichstädt, and honored with the title of elector. Austria obtained the Tyrolese archbishoprics, Trent and Brixen, and, notwithstanding its cessions of territory to France, had gained, including its acquisitions in Poland, 9,580 square miles; this made the whole extent 253,770 square miles. The public debt had also increased to 1,220,000,000 florins.

The first consul of France now caused himself to be proclaimed emperor; and 11 Aug. 1804, Francis declared himself hereditary Emperor of Austria, and united the Austrian states under the name of the Empire of Austria. Immediately after this important act he took arms once more with his allies, Russia and Great Britain, against the government of France. The war of 1805 was terminated by the peace of Presburg (26 Dec. 1805). By the conditions if the treaty Francis was obliged to cede to France the remaining provinces of Italy; to the King of Bavaria, Burgau, Eichstädt, a part of Passau, all Tyrol, Vorarlberg, Hohenembs, Rothenfels, Tettnang, Argen and Lindau; to the King of Würtemberg the five towns lying on the Danube, the county of Hohenberg, the landgraviate of Nellenburg, Altdorf and a part of Brisgau; and to the Grand Duke of Baden the remainder of Brisgau, Ortenau, Constance

and the commandery of Meinau. He received, in return, Salzburg and Berchtesgaden; the Elector of Salzburg was compensated by the province of Würzburg; and the dignity of grand master of the Teutonic order was made hereditary in the house of Austria. Thus ended a war which cost the Austrian monarchy, besides the territories just enumerated, 90,000,000 florins, which were carried away by the French from Vienna, and 800,000,000 for the other expenses of the war; of which Francis paid a large proportion from his private purse. After the formation of the Confederation of the Rhine (12 July 1806) Francis was forced to resign his dignity as Emperor of Germany (6 Aug. 1806), which had been in his family more than 500 years. The old German, or Holy Roman Empire thus came to an end, and Francis had now only the title of Francis I, Emperor of Austria. In 1809 he resolved on a new war with France, aided by Great Britain, which did nothing more than furnish some pecuniary assistance and made a useless attack on Walcheren. Austria fought courageously, but in vain. The peace of Vienna (14 Oct. 1809) cost the monarchy 42,380 square miles of territory, 3,500,000 subjects and more than 11,000,000 florins of revenue. The public debt was also increased to 1,200,000,000 florins, and all the paper money in circulation was estimated at 950,000,000.

Napoleon, after tearing from the Austrian monarchy its fairest provinces — the duchy of Salzburg, with Berchtesgaden, Innviertel, western Hausruckviertel, Carniola and Görz, Trieste, the circle of Villach, a large part of Croatia, Istria, a part of the Grisons, the Bohemian territories in Saxony, all west Galicia, the circle of Zamoski in east Galicia, Cracow, with half the salt works of Wieliczka, the circle of Tarnopol and many other territories which were given to Russia — formed a personal connection with the ancient family of Hapsburg, by his marriage with Maria Louisa, daughter of the Emperor of Austria, and (14 March 1812) concluded an alliance with the Emperor Francis against Russia. But the Emperor of France was repulsed on his invasion of this country; Prussia rose up against him; and after the Congress of Prague had separated without accomplishing anything, Francis, 12 Aug. 1813, declared war against France, and formed an alliance, 9 Sept. 1813, at Teplitz, with Great Britain, Russia, Prussia and Sweden, against his son-in-law. In the battle of Leipsic, the Austrian troops took an honorable part. The firmness with which the Emperor signed the act of proscription against his son-in-law, and fixed the fate of his daughter and her infant, excited general respect. He signed the same act against Napoleon a second time, when he returned from Elba. He also opposed Murat in Italy. Yet the Austrian Cabinet endeavored to provide for young Napoleon in the settlement of the affairs of France. By the Congress of Vienna, 1814–15, Austria gained the portion of Italy which is usually known as Lombardy and Venetia, and recovered, together with Dalmatia, the hereditary territories which it had been obliged to cede. The former Grand Duke of Würzburg, on the contrary, ceded his territory to Bavaria, and again took possession of Tuscany. The final act resulting from the congress was signed in 1820. In 1821 liberal movements in Italy were put down. The July revolution of 1830, in France, caused warlike preparations to be made; but after Great Britain had acknowledged the new government Austria acknowledged it also. Insurrections which took place in Modena, Parma and the Papal states, 1831–32, were suppressed without much difficulty. In the London conference relative to the affairs of Belgium Austria took an active share; but in proportion as Great Britain and France became more closely united, Austria entered into more intimate relations with Russia and Prussia. In the Polish insurrection Austria ultimately gave indications of a strong leaning in favor of Russia. The death of the Emperor Francis I, 2 March 1835, and the accession of Ferdinand I made little change in the Austrian system of government. Metternich still continued at the head of affairs and to foster the reactionary policy. In 1846 the failure of the Polish insurrection had led to the incorporation of Cracow with Austria, but discontent with the government very widely prevailed in the empire. In Italy, the declarations of Pio Nono in favor of reform, and the concessions into which most of the other governments of the Italian Peninsula had been hurried, increased the difficulties of Austria. In Hungary the constitutional opposition became stronger and stronger, and latterly, under the guidance of Kossuth and other popular agitators, assumed the form of a great constitutional movement. In 1848 the expulsion of Louis Philippe shook all Europe to its foundations. Metternich found it impossible any longer to guide the ship of state, and the government found itself compelled to grant a free press, and allow the citizens freely to arm themselves. The popular movement made great progress in Hungary; and in Italy a formidable insurrection broke out, threatening the very existence of the Austrian power in the peninsula. In the very centre of the empire, in Vienna itself, the insurrection made equal progress, and the royal family, no longer in safety, removed to Innsbruck. The Austrian monarchy appeared now to be hanging by a thread. The Hungarian Diet declared itself permanent, under the presidency of Kossuth. Various ministerial changes took place, and at last the Emperor abdicated in favor of his nephew, Francis Joseph. More vigorous measures were now adopted, and Austria, strongly aided by the forces of Russia, who feared a revolution within her own borders, succeeded in suppressing the Hungarian insurrection. Haynau, on the occasion, rendered himself notorious by his severity, and Hungary underwent the fate of a conquered country. The year 1855 is memorable in Austrian history for the conclusion of a concordat with the Pope which put the educational and ecclesiastical affairs of the empire entirely into the hands of the Papal see. It established an ecclesiastical censorship of the press, and placed all schools, even private schools, under surveillance of the bishops; it proclaimed the complete independence of the bishops in relation to the civil government, so that all decrees proceeding from Rome might be published without obtaining the royal *placet*, and it authorized the bishops to convoke the provincial councils and diocesan synods without the consent of the civil authority. In 1859 the hostile intentions of France and Sardinia against the possessions of Austria in Italy be-

came so evident that she declared war by sending an army across the Ticino, but after disastrous defeats at Magenta and Solferino she was compelled to cede Milan and the northwest portion of Lombardy to the Sardinian King. In 1864 she joined with Prussia and the other German states in the spoliation of Denmark, but a dispute about the conquered provinces of Schleswig-Holstein involved her in a war with her allies (1866), while at the same time Italy renewed her attempts for the recovery of Venice. Austria had accordingly to show front both in the north and in the south. The southern army under Archduke Albert fought successfully, defeating the Italians under Victor Emanuel at Custozza, 24 June, and driving them back across the Mincio, but the fortune of the northern army under General Benedek was very different. On 3 July Benedek was completely defeated by the Prussian forces at Königgrätz (Sadowa) in Bohemia, and the road to Vienna lay open to the victors. Francis Joseph now ceded Venetia to Napoleon III, and claimed his intervention to assist in procuring a peace, evidently wishing to make a separate treaty with Italy, so as to be at liberty to employ the southern army against Prussia. This design did not succeed, however. Both Italy and Prussia were willing to accept the mediation of Napoleon, but Italy would not hear of a separate arrangement and continued the war. On 20 July Admiral Tegetthoff defeated the Italian fleet near the Dalmatian island Lissa: but, on the other hand, the Prussians continued to advance into Austria and threatened Vienna. Francis Joseph accordingly saw himself obliged to conclude a peace with Prussia 23 August, and a little later peace was concluded with Italy also, 3 October. The result of the war was the cession of Venetia through France to Italy, and the withdrawal of Austria from all interference in the affairs of Germany. See SEVEN WEEKS' WAR.

After 1866 Austria was occupied chiefly with the internal affairs of the empire. The first aim of the government was to restore the Constitution of the state, which had been established in February 1861, but which had been suspended since 1865 owing to the demand of Hungary for self-government. As Austrian statesmen were anxious for a settlement of the dispute, the Hungarian demands were finally agreed to, and the empire of Austria divided into two parts, the one made up of the Cisleithan or Slavonic-German provinces, the other of the Transleithan provinces, the latter forming together the kingdom of Hungary. These two divisions of the empire were to be entirely independent, except in matters of diplomacy and military and naval matters — to some extent also in matters of finance. This settlement was consummated by the coronation of the Emperor Francis Joseph I as King of Hungary, which took place at Pesth-Ofen, on 8 June 1867. During the session of the Reichsrath, that is, the Diet of the Cisleithan provinces, held in the same year, the important question of the concordat of 1855 came up for discussion. The Liberal majority in the Diet were desirous of seeing it entirely repealed, but as they fully recognized the insuperable obstacles in the way of this step, they were content to proceed by separate enactments intended to weaken the power that had been gained to the Papal see by the concordat. With this end in view three measures were brought forward, one for the re-establishment of civil marriage, one for the emancipation of the schools from the domination of the Church and one for the placing of the different creeds on a footing of equality. Before 25 May 1868, all these measures had passed through both houses of the Diet, and on that day they received the imperial sanction. These laws were declared by the Pope to be "abominable," as well as null and void. Further enactments having in view the weakening of the power of the papal see in the state were passed in 1874 and were condemned by the Pope in the severest terms. The fact of the Austro-Hungarian dominions comprising so many different nationalities with different languages has always given the government much trouble, both in the management of the internal affairs and in regard to external matters. In the Eastern question, for instance, the course of Austria was hampered by the sympathy shown by the Magyars for the Turks, while her Slav subjects were naturally more favorable to Russia, Serbia and Montenegro. Previous to the outbreak of hostilities between Russia and Turkey she joined with the other powers in remonstrance with Turkey, but as to the actual struggle remained neutral. At the close of the war in the middle of 1878 Austria took part in the Congress of Berlin, where the settlement of the Eastern question was arranged, and by this congress it was decided that the provinces of Bosnia and Herzegovina should in future be administered by Austria-Hungary instead of Turkey.

The occupation of Bosnia and Herzegovina, however, was not accomplished without a fierce struggle, and simply added new factors to the incessant internal friction which continued between the different nationalities and political factions of the empire. This was not diminished by the final act of annexation, 13 Oct. 1908. In 1907, following two years of persistent agitation throughout the empire, the law of general manhood suffrage was passed, and resulted, in ensuing elections, in the accession of a great number of socialistic members to both Parliaments and the common Delegations. While internal turmoil did not abate, Austrian external policy was also disturbed by the results of the Balkan Wars of 1912 and 1913, the defeat of Turkey and Bulgaria, and the increased influence of Russia as the "big brother" of the Slav nationalities. The trend of events culminated in a crisis when on a visit to Bosnia, the Crown-Prince Ferdinand and his consort were assassinated at Sarajevo by two Austrian subjects of Serbian extraction 28 June 1914. See AUSTRIA-HUNGARY AND THE WAR; and WAR, EUROPEAN.

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Revised and supplemented by DR. W. M. PETROVITCH.

AUSTRIA-HUNGARY, Diplomatic Relations. Austria, declining in European influence and pecuniary resources at the time of the American Revolution, had little trade attractions for the United States, except through the city of Ostend. Her answer to Arthur Lee and to William Lee gave evidence that she would probably be the last European power to recognize American independence; but in 1781 she joined Russia in a proposal for mediation which accepted by Congress led to negotiations resulting in peace with independence. She attracted very little attention in the United States before the meetings of the Vienna Congress. The American government declined an invitation to participate in the meetings of the Holy Alliance, but in 1823 Monroe appointed a confidential agent to observe and report its activities. Commercial intercourse, insignificant at first, increased after the close of the Napoleonic wars and in 1829 resulted in the negotiation of a treaty of commerce and navigation.

Regular diplomatic relations began with the American appointment of Nathaniel Niles as agent (in 1837) to procure a modification of duties and restrictions on the importation of American tobacco, and the Austrian appointment of Baron de Mareschal as Envoy Extraordinary and Minister Plenipotentiary in 1838. A treaty relating to property and consular jurisdiction was negotiated in 1848, followed by a treaty of extradition in 1856. Under the stimulus of democratic expansion and "manifest destiny" at the middle of the century, the United States exhibited a deep sympathy for Hungary (in her unsuccessful struggle against Austria and Russia) which induced the American government in 1849 to send an agent, A. Dudley Mann, with a view to the recognition of the Hungarian republic, and led Congress in 1849, after Hungary was crushed, to offer an asylum to Kossuth and his fellow exiles and to give a public reception to Kossuth on his visit to Washington. The Mann mission, when it became known, was the subject of a strong protest of Austria through her chargé-d'affaires, M. Huelsemann, to whom Webster made a vigorous and spirited reply and who temporarily withdrew from Washington soon after the Kossuth craze.

In 1853 new friction arose in the case of Martin Koszta, a Hungarian refugee to the United States, who, having returned to Europe after declaring his intention to become an American citizen, had been seized in a Turkish port by an Austrian cruiser. His forcible release from the vessel by Captain Ingraham of the United States war vessel brought from Huelsemann a demand for reparation and disavowal which Secretary Marcy refused to give. At the close of a diplomatic warfare, Austria surrendered her claim to jurisdiction over Koszta who returned to the United States with the understanding that Austria could proceed against him in case he should ever return to Turkey. Apparently friendly to the United States at the opening of the secession struggle, Austria never accorded belligerent rights to the Confederates. In the summer of 1863 Motley reported that she was recruiting troops to accompany Maximilian to Mexico and submitted to the Austrian government some unauthorized views in regard to the Mexican question for which Seward censured him. At the close of the war, however (in 1867), Motley was instructed to warn Austria not to send volunteers to replace the French troops in Mexico, and when he hesitated to act Seward disapproved his delay and effectively directed him to file a protest at once and to withdraw from Vienna in case the departure of the troops was permitted.

Since the Civil War, questions relating to naturalization and expatriation have been the most prominent and most persistent. Although the naturalization convention of 1870 with Austria-Hungary recognizes the right of citizens or subjects of one country to become citizens or subjects of the other after an uninterrupted residence of five years, its interpretation has frequently been a subject of diplomatic discussion in connection with the arrest of persons who, born in Austria or Hungary, had emigrated to the United States before the performance of their military service, and often to escape it, and after meeting the requirements for American citizenship had returned to their native land to reside permanently, enjoying all the privileges of the government without sharing its burdens and responsibilities, and perhaps creating discord and loudly boasting of their immunity from military service. The Austro-Hungarian government, claiming that the citizenship of many such *pseudo-Americans* had been obtained *in fraudem legis*, or that it had never been completed, summoned them to military duty; in case of their refusal to serve, it arrested them; and, in some instances of ostentatious evasion, while feeling bound by treaty stipulations, it resorted to expulsion from the country under a law of 1871, asserting that the presence of the persons expelled exerted a pernicious influence in the community of their origin and that the treaty of 1870 gave American citizens no right to permanent residence in the country. The earlier friction arising from such cases

greatly decreased by 1900, however, as a result of the steady progress made toward their satisfactory settlement through more precise information. Arrests became more infrequent. On the representations of the American legation in worthy cases the Austrian government observed treaty provisions in the larger number of arrests of American naturalized citizens for alleged evasion of military service and released them from military obligations. Representations against expulsion were made only when its adoption appeared unduly onerous. In November 1899, on the ground that so many Austro-Hungarians had taken advantage of treaty stipulations to become nominally citizens of the United States with the sole object of living in their native country in defiance of its military laws, the Austrian legation at Washington renewed a proposal (which had been offered as early as 1883 as a result of the military law of 1882) for a modification of the naturalization treaty of 1870 by which the American government would no longer feel obliged to extend protection to mala-fide citizens, and the Austrian government would no longer feel compelled to expel them. The American Department of State which in reply to similar prior proposals had admitted that this abuse of treaty stipulations should be discontinued, and still admitted that there were "doubtless grave abuses of the privileges of naturalization," declined to accept the proposal for amendments which would have annulled beneficial treaty provisions preventing the subjection of bona-fide naturalized citizens to military service. In June 1896, the Austro-Hungarian legation at Washington suggested the necessity of using a form of naturalization oath which should "mention the fact of the existence of separate Austrian and Hungarian citizenship." Among other questions affecting diplomatic relations since 1870, Austrian tariffs and trade restrictions (especially on meats and fruits) stand first. Trade relations were improved by the reciprocity arrangement of 1892, but obstructions to American imports still threatened to provoke retaliatory inspection of Austrian imports into the United States.

Still other questions arose. In 1885 Austria objected to the appointment of A. M. Keeley as American Minister at Vienna on the double ground of his want of political tact and his Jewess wife — neither of which appeared valid to the American State Department. In 1891 there was considerable correspondence relating to the question of preventing the emigration of defective, dependent and delinquent classes.

Although Austria sympathized with Spain in the Spanish-American War, her authorities at Trieste gave a friendly reception to Admiral Dewey in 1899. In 1909 she agreed to an arbitration treaty with the United States.

The American government, when it declared war against Germany in the spring of 1917, hoped to avoid the necessity of a declaration against Austria-Hungary, Germany's ally; but, by the conditions of the war, it finally, in the following December, found it necessary to declare war against Austria-Hungary also.

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AUSTRIA-HUNGARY AND THE WAR. The position of the Dual Monarchy in regard to the European War will long remain a controversial topic for historians to debate. Whatever light the future may throw upon the subject, it is at least now possible to point definitely to the Austro-Hungarian ultimatum to Serbia on 23 July 1914 as the direct or immediate cause of the great conflagration. It is equally established that the grounds for the ultimatum were furnished by the assassination of the Archduke Francis Ferdinand and his wife at Serajevo, the capital of the Austrian province of Bosnia, on 28 June 1914. The Austrian government charged that the crime had been instigated in Serbia and by Serbian officials. A storm of anti-Serbian feeling swept over Austria and Hungary; the members of the Serb party in the Provincial Council of Croatia were assailed by their colleagues with cries of "Serbian assassins," while excited mobs in Vienna threatened the Serbian legation. The Austrian press demanded the punishment of Serbia. On 23 July the Austro-Hungarian government presented the ultimatum to Serbia. Thus it may be said that the war took its rise from the murder of an archduke and the indignation of Austria against Serbia, where the plot was alleged to have been hatched. These antecedent conditions do not, however, explain how a purely local quarrel came to embroil the whole world. So far as the two original belligerents — Austria-Hungary and Serbia — are concerned, the following review of their past relations will serve to show that the Serajevo tragedy was but the culminating point — the last straw — that brought a long-standing quarrel to a head.

The Austrian defeat by Prussia at Sadowa in 1866 compelled the house of Hapsburg to seek a new centre of gravity in the southeast. The German victories over France in 1870 and 1871 placed the Austrian dream of revenge beyond hope of fulfilment. But meantime, between Sadowa and Sedan, Austria had admitted Hungary to full partnership in the Monarchy with a view to a fresh struggle against the German empire. When, after the Franco-German War, the Emperor Francis Joseph realized the necessity of admitting also his Slav subjects to partnership in the Monarchy, he found in the existence of the Dual System an insuperable obstacle to his scheme. Geographically hemmed in by Slav populations, Hungary had always pursued a strongly anti-Slav policy, working on the principle that the Slavs, and particularly the Serbo-Croatians, both in the Monarchy and in the kingdom of Serbia, must be kept in a state of subjection. Under the Hungaro-Croatian settlement of 1868, which resulted from the Dual System, the inhabitants of Croatia-Slavonia, constitutionally subjects of the Hungarian crown, were oppressed and their development impeded, while continual discord was fomented and encouraged between the Croatian, or Roman Catholic branch of the Southern Slav race, and the Serbo, or Orthodox branch. The occupation of Bosnia-Herzegovina (q.v.) in 1878 formed part of the policy of ruling the Southern Slav race and of keeping the various branches divided in order to rule them the more effectively. At the same time Austro-Hungarian diplomacy sought to gain control over the kingdom of Serbia, which for

many years stood practically under Austrian tutelage. After the defeat of Serbia by Bulgaria in 1885, Austria intervened as a protector to check the Bulgarian advance. Not until after the expulsion of King Milan (q.v.) in 1899 did Serbia begin to emancipate herself from Austrian control. The young King Alexander showed a disposition to turn toward Russia, but his unfortunate marriage made him unpopular and led to his murder on 11 June 1903. The accession of Peter Karageorgevitch promised more friendly relations between Serbia and Austria, but trouble arose in 1905 when Serbia concluded a customs union with Bulgaria. This prospect of economic union between two Balkan Slav states was so distasteful to Austria-Hungary that the government immediately declared a tariff war against Serbia and excluded all her cattle and agricultural produce. Serbia resisted the attack to the best of her ability and succeeded in finding new markets in France, England and Egypt. From this tariff war, which lasted several years, dates the growth of the Serbian spirit of economic and political independence and the accentuation of Serbian resentment against Austria-Hungary.

Under Russian guidance a conciliatory spirit was meanwhile spreading among the Southern Slavs of the Dual Monarchy. At a conference held in Fiume October 1905 a resolution was adopted that ended the old feud between Roman Catholic Croatians and Orthodox Serbs. Regarding this reconciliation as a conspiracy rather than a spontaneous movement, the Hungaro-Croatian authorities in 1907 arrested 53 Southern Slavs, who were accused of high treason on the strength of denunciations by an *agent provocateur*. The trial of these individuals at Agram developed into a judicial scandal; it lasted two years and ended in acquittal of the defendants. In 1908 Baron Aehrenthal (q.v.) utilized an alleged Pan-Serb conspiracy as a pretext for annexing Bosnia and Herzegovina (q.v.). The annexation aroused the deepest indignation in Serbia, where hopes of adding the two provinces to the kingdom had long been entertained. These aspirations were based upon the fact that the population of the provinces is entirely Serb, though divided by religion into Roman Catholic, Orthodox and Mohammedans. The Bosnia-Herzegovina coup brought Austria no practical advantage; the provinces were her own to all intents and purposes, and few seriously believed or even wished that they would ever be handed back to Turkey or be permitted to fall to Serbia. What the event did, however, was to draw upon Austria the hostility of Russia and Serbia and to teach the smaller Balkan states that they could achieve their national aims only by united action and in disregard of the Great Powers. Accordingly, they formed a new and formidable power bordering on Austria-Hungary and looking forward to the acquisition of provinces in that empire inhabited by people of their race. Austria-Hungary thus became exposed to a double menace: besides that of the "Italia Irredenta" of the Trentino and Trieste, the prospect of a "Slavonia Irredenta" in Croatia, Dalmatia, Bosnia, Herzegovina, Istria, Carniola and Carinthia and a "Rumania Irredenta" in Transylvania and Bukovina. Even her naval power in the Adriatic was imperilled by her abandonment (at the time of the annexation) of the Sanjak of Novi Bazar, which barred the access of Serbia to that sea, and Serbia's claim to an Adriatic port, now that the way was open to her, brought Austria-Hungary to the verge of a war with her and her protector, Russia, already in 1909.

The members of the Serbo-Croatian coalition in the Diet of Agram, the capital of Croatia, prosecuted an Austrian semi-official writer, the historian Dr. Friedjung, in December 1909 for libel. Friedjung had laid charges of treasonable commerce with Serbia against the members, who proved, at the trial, that the historian had based his accusations on forged documents which had been supplied to him by the Austrian Foreign Office. These documents, tending to prove a Pan-Serbian conspiracy against Austria-Hungary, had been forged by an individual who was in the employ of the Austrian legation at Belgrade. The Serbian government prosecuted the forger, who received 15 years' imprisonment. In course of time a strong sympathy with Serbia became general among the Southern Slavs of the Monarchy. When the Balkan League (q.v.) was formed in 1912 against Turkey, it was understood to be directed in almost equal measure against Austria-Hungary, which country was suspected of harboring a design to humiliate Serbia and reduce her to her former position of dependence. The murdered Archduke Francis Ferdinand was regarded as the head of the anti-Serbian military and clerical party in Austria. He had fully estimated the vital importance of the Southern Slav question for Austria; he wished to upset the Dual System, which he regarded as the main obstacle to proper treatment of the Austro-Hungarian Southern Slavs, and at the same time to find a Roman Catholic "Croatian," as opposed to a Serb Orthodox, solution for the problem. On the outbreak of the Balkan War (q.v.) in October 1912, the military party in Austria desired armed intervention against Serbia. Their wish was overruled, mainly because it was expected that the Turks would defeat the Serbians and that Austria would then be able to intervene again, as in 1885, save Serbia from ruin and re-establish political control over the kingdom. Contrary to expectations, however, it was the Turks who were defeated, a circumstance that was deeply deplored in Vienna, while the ensuing quarrels between the Balkan allies over the division of the spoils were heartily encouraged by Austrian diplomacy. The second Balkan War was directly due to the influence of Austro-Hungarian diplomacy upon King Ferdinand of Bulgaria, who undertook to crush Serbia but was himself defeated. During the peace conference held in London in the winter of 1913 and in the ambassadorial conferences that accompanied it, Austria-Hungary and her allies successfully exerted their influence to prevent Serbia from acquiring a port on the Adriatic. At that time the Serbian Premier, M. Pashitch, made overtures for a direct settlement to Count Berchtold (q.v.). He offered considerable economic and financial concessions to Austria-Hungary and begged Count Berchtold to use his influence to secure satisfaction for the legitimate aspirations of

Serbia to a commercial port. He offered binding guarantees that this port would be purely commercial and urged that friendship would be sealed between the two countries by such a proof of Austro-Hungarian good will. These overtures were summarily rejected. Austria-Hungary was the only great power that had any vital interest in the Balkan question, and it was no doubt her grave concern that her neighbor Serbia should not become too strong. Influential persons in the empire came to the conclusion that the only effectual way of securing this object was to compel Serbia to submit to Austrian dictation by force of arms. This process was seriously under consideration in 1913, but Count Berchtold, supported by the Emperor, held that this would be too risky a policy, as it might not only involve a war with Serbia and her allies, but also with Russia. He therefore hit upon the idea of creating a buffer state of Albania, whose harbors on the coast would be open to Serbia for purposes of trade only. But Russia insisted that some compensation should be made to Serbia for the Albanian territories she had conquered in the Balkan War and would now have to surrender again. At the time Russia had a large army on the Galician frontier, which compelled Austria to retain her troops there. Negotiations between the Emperor and the Tsar led to an agreement whereby Serbia received the principal Albanian towns on her frontier, Ipek, Prizrend, Dibra and Diakova. Thus was the spectre of a European war removed in 1913. But not for long. The Serajevo assassinations in 1914 fanned the slumbering embers of animosity once more into flame. It was immediately realized by those acquainted with the past history that Austria-Hungary might take advantage of the murder as a reasonable excuse for invading Serbia, and that, if the struggle could be localized, it might well end in the annihilation of Serbia. But success in this direction would not have brought the Dual Monarchy a solution of the Southern Slav problem, for though conquest might indeed bring Serbia under Austro-Hungarian domination, it would have tended to unite within the Monarchy all the branches of the Southern Slav race and raised in an acute form the question of the stability of the Dual System, that legacy of Sadowa which was the primary cause of the ill-treatment and disaffection of the Southern Slavs within the Austrian empire and of the perpetual agitations and plottings of the other Slavs outside.

The ultimatum presented at Belgrade on 23 July demanded a reply before 6 P.M. on the 25th. It stated that "the history of recent years has shown the existence in Serbia of a subversive movement with the object of detaching a part of Austria-Hungary from the Monarchy — a movement which had its birth under the eyes of the Serbian government, and was carried out by a series of acts of terrorism, outrages and murders." The Serbian government had "done nothing to repress the movement"; it had permitted "the criminal machinations of various societies and associations," had "tolerated apologies for the perpetrators of outrages and the participation of Serbian officers and civil officials in the movement," and had "permitted all the manifestations which have incited the Serbian people to hatred of the Monarchy and contempt of its institutions." The assassinations had been traced to Belgrade, and it was therefore impossible for the Austro-Hungarian government "to pursue any longer the attitude of expectant forbearance which it had maintained for years in face of the machinations started in Belgrade and thence propagated to the territories of the Monarchy." The Serbian government was demanded to publish a declaration on the front page of the *Official Journal* for 26 July to the effect that "it condemns the movement whose final aim is to detach from the Austro-Hungarian Monarchy territories belonging to it," and that it "regrets that Serbian officers and civil functionaries have participated in the movement and thereby compromised the neighborly relations to which Serbia was solemnly pledged by its declaration of 31 March 1909." The following categorical demands were also made:

1. The suppression of all publications inciting to hatred and contempt of the Austro-Hungarian Monarchy or whose tendency is directed against its territorial integrity.
2. Immediate dissolution of the society *Narodna Obrana* and confiscation of all its means of propaganda; also of all other societies with the same objects.
3. Elimination from public instruction in Serbia of everything serving to foment the propaganda against Austria-Hungary.
4. Removal from the service of all officers and civil functionaries guilty of such propaganda whose names and acts shall be communicated by the Austro-Hungarian government to that of Serbia.
5. Representatives of the Austro-Hungarian government to be accepted by Serbia for the purpose of collaborating in the suppression of the above propaganda.
6. Judicial proceedings to be taken against accessories to the plot of 28 June who are on Serbian territory, and delegates of the Austro-Hungarian government to take part in the investigation relating thereto.
7. The immediate arrest of Major Jankasitch and the Serbian state functionary, Ciganovitch, who were found to be implicated in the plot at the official inquiry at Serajevo.
8. The prevention by effective measures of the co-operation of the Serbian authorities in the illicit traffic in arms and explosives across the frontier, and the dismissal and severe punishment of the officials of the frontier service who had facilitated the passage of the frontier for the perpetrators of the outrage.
9. Explanation of the utterances of high Serbian officials, both in Serbia and abroad, who notwithstanding their official position did not hesitate after the crime of 28 June to express themselves in terms of hostility to the Austro-Hungarian government.
10. Notification to the Austro-Hungarian government without delay of the execution of the measures comprised under the preceding heads.

The feverish activity occasioned by the Austrian Note among the chancelleries of Europe, the exchange of telegrams and resultant consultations and negotiations between the Powers, will be found under WAR, EUROPEAN: DIPLOMATIC HISTORY. The Serbian reply, delivered within the stipulated time, accepted "in principle," but with certain reservations, nearly all the Austrian demands. Serbia protested, however, against the claim that Austro-Hungarian officials should take part in the judicial inquiry on Serbian territory and in the suppression of propaganda, and suggested that the matter should be settled by arbitration. The reply was deemed unsatisfactory; Austria declared war on Serbia 28 July 1914 and opened hostilities on the 29th by bombarding Belgrade. The Austrian case for commencing the war was published in a manifesto by the late Emperor Francis Joseph, dated Ischl, 28 July: "To my peoples! It was my fervent wish to consecrate the years which, by the grace of God, still remain to me, to the works of peace and to protect my peoples from the heavy

sacrifices and burdens of war. . . . The intrigues of a malevolent opponent compel me, in the defense of the honor of my Monarchy, for the protection of its dignity and its position as a Power, for the security of its possessions, to grasp the sword after long years of peace. With a quickly forgetful ingratitude, the kingdom of Serbia, which, from the first beginnings of its independence as a state until quite recently, had been supported and assisted by my ancestors, has for years trodden the path of open hostility to Austria-Hungary. When, after three decades of fruitful work for peace in Bosnia and Herzegovina, I extended my sovereign rights to those lands, my decree called forth in the kingdom of Serbia, whose rights were in nowise injured, outbreaks of unrestrained passion and the bitterest hate. My government at that time employed the handsome privileges of the stronger, and with extreme consideration and leniency only requested Serbia to reduce her army to a peace footing and to promise that, for the future, she would tread the path of peace and friendship. Guided by the same spirit of moderation, my government, when Serbia, two years ago, was embroiled in a struggle with the Turkish empire, restricted its action to the defense of the most serious and vital interests of the Monarchy. It was to this attitude that Serbia primarily owed the attainment of the objects of that war. The hope that the Serbian kingdom would appreciate the patience and love of peace of my government and would keep its word has not been fulfilled. The flame of its hatred for myself and my house has blazed ever higher; the design to tear from us by force inseparable portions of Austria-Hungary has been made manifest with less and less disguise. A criminal propaganda has extended over the frontier with the object of destroying the foundations of state order in the southeastern part of the Monarchy; of making the people to whom I, in my paternal affection, extended my full confidence, waver in their loyalty to the ruling house and to the Fatherland; of leading astray its growing youth and inciting it to mischievous deeds of madness and high treason. A series of murderous attacks, an organized, carefully-prepared and well-carried-out conspiracy, whose fruitful success wounded me and my loyal peoples to the heart, forms a visible bloody track of those secret machinations which were operated and directed in Serbia. A halt must be called to these intolerable proceedings and an end must be put to the incessant provocations of Serbia. The honor and dignity of my Monarchy must be preserved unimpaired. . . . In vain did my government make a last attempt to accomplish this object by peaceful means and to induce Serbia, by means of a grave warning, to desist. Serbia has rejected the just and moderate demands of my government and refused to conform to those obligations, the fulfilment of which forms the natural and necessary foundations of peace in the life of peoples and states. I must therefore proceed by force of arms to secure those indispensable pledges which alone can insure tranquillity to my states within and durable peace abroad." Finally, the Emperor declared that "in this solemn hour I am fully conscious of the whole significance of my resolve and my responsibility before the Almighty"; that he had "examined and weighed everything," and with a serene conscience would "set out on the path to which duty points."

It is important to record that Count Berchtold strove up to the last for a pacific issue. He repeatedly asked the Emperor to be relieved of his post and only remained at the Foreign Office to carry out a policy distasteful to him out of loyalty to his Imperial master. On 31 July, three days after he had launched the fateful declaration of war, Count Berchtold announced in London and Paris that he would consent to submit to mediation the points in the Note to Serbia which seemed incompatible with the maintenance of Serbian independence, but the matter had by that time passed into the hands of Germany and the Austro-Hungarian leaders and could not be pursued diplomatically any further. Russia would not permit Serbia to be crushed and supported the proposal of Sir Edward Grey (q.v.) for a conference. Germany rejected that proposal, favored localizing the dispute and upheld the stand taken by Austria-Hungary. Germany had further issued a general warning on 26 July that she would not tolerate interference with the Austrian resolve to punish Serbia, and demanded of Russia the immediate cessation of a reported mobilization. This was followed by a German declaration of war against Russia on 1 Aug. 1914; against France, 3 August; and against Belgium, 4 August. On the last-named date came the British ultimatum regarding the neutrality of Belgium, and by 11 o'clock in the evening Great Britain was also a belligerent. Holland, Belgium and Switzerland had meanwhile mobilized to defend their neutrality. Austria declared war on Russia 6 August; Montenegro on Austria 7 August; France declared war on Austria 10 August, and Great Britain on 13 August. Then followed the Austrian declaration of war on Japan, 27 August; on Belgium, 28 August; Italy turned against her former ally on 23 May 1915; Rumania declared war on Austria 27 Aug. 1916, and the United States on 7 Dec. 1917. During the progress of the war the venerable Emperor Francis Joseph I died in his 86th year and the 68th year of his reign, on 21 Nov. 1916. He was succeeded by his grandnephew under the title of Charles I (q.v.). Consult Steed, W., 'What is Austria?' (*Edinburgh Review,* October 1917).

See AEHRENTHAL, BARON; BALKAN LEAGUE; BALKAN WARS; BERCHTOLD, COUNT; BOSNIA; EASTERN QUESTION; FRANCE AND THE WAR; GERMANY AND THE WAR; GREAT BRITAIN AND THE WAR; MONTENEGRO; RUSSIA; SERBIA; WAR, EUROPEAN.

HENRI F. KLEIN,
Editorial Staff of The Americana.

AUSTRIAN SUCCESSION. See SUCCESSION WARS.

AUTHORS, American, Society of, an organization founded in New York in 1892, and incorporated in 1895, having for its objects the promotion of a professional spirit among authors and a better understanding between authors and their publishers, and, in general, the

protection of literary property and the advancement of the interests of American authors and literature. All persons engaged in literary pursuits are eligible to membership. The Society has a pension fund for members who may become needy.

AUTHORS, British, Society of, an association of authors formed in London in 1883, for social and business purposes. It has a governing committee of 30 members; maintains an attractive clubroom and publishes a periodical called *The Author.*

AUTHORS, French, Society of, an organization founded in Paris in 1837, for the protection of authors in their rights, and open to any man of letters. It is governed by an elective committee of 24 members and has a pension fund which provides for aid in work, for sickness and in old age. Besides publishing a journal, the *Chronique,* the Society has recovered a large sum of money from pirating publishers.

AUTHORS' CLUB, an American organization founded in New York in 1882, and incorporated in 1887. It is governed by an executive committee without a president. Any person who is the author of a published book proper to literature, or of creditable literary work equivalent to such a book, is eligible to membership. The Club holds meetings semi-monthly, and gives Saturday receptions for ladies in the winter season. It has a library consisting of the publications of its members and another devoted to literary biography.

AUTHORS' LEAGUE OF AMERICA, The, Inc., was organized as a protective association for all persons producing copyrightable material, or in the words of the League constitution "all persons actually engaged in literary, dramatic, musical or artistic composition." It is the object of the League to supply its members with full information as to the business side of their work and to assist them in safeguarding and maintaining their rights. In somewhat over three years the membership had grown to 1,300 and is at present steadily increasing. The income of the League is derived entirely from membership dues. The membership is divided into three classes: Life membership, regular membership, associate membership. The latter class is restricted to publishers, editors, agents and others who are not directly engaged in writing or other artistic production.

AUTO-DA-FE, ou'to dä fā (Portuguese, act of faith), the solemn public act that from 1481 to 1810 was performed in Spain and Portugal at the execution of those condemned to death by the Inquisition. It took the form of a procession through the chief streets of the city or town to the church where a sermon was preached on the true faith, after which, the condemned were turned over to the secular power. The procession was usually witnessed by multitudes, many believing that it was an act of merit to assist at such a function, others in fear of the terrible Inquisition lent their presence as a matter of expediency. The procession was led by the Dominicans, who were long among the chief inquisitors; they were followed by those who were condemned only to perform public penance. A great cross separated these from those condemned to death. The latter were clad in a garment called the san benito, a kind of shirt inscribed with the crimes of the victim and painted with infernal symbols. They wore also a pointed cap on the head. Next came effigies of the fugitives and the bones of dead culprits. The rear was brought up by numerous priests and monks. The most elaborate Auto-da-fé was that of Madrid in 1680 under Charles II. The system persisted down to the end of the first decade of the 19th century, and five years longer in America, the last recorded event of this kind taking place in Mexico as late as 1815. For the crimes, mode of execution, number of victims, etc., see general article INQUISITION.

AUTO-INTOXICATION. This term signifies poisoning from substances which are formed within the body. These substances may be the normal products of metabolism which are normally changed to inert or harmless bodies in the chemistry of the different organs, or are eliminated by the proper eliminative organs, or they may be the product of bacteria or of bacterial action upon decomposable or fermentable material which is found by the bacteria of the alimentary canal in the stomach or intestines. These substances are absorbed from the gastro-intestinal canal and passing into the blood are conveyed to various parts of the body and produce their characteristic symptoms. This can readily be understood when we realize that a very considerable portion of the food material which is taken into the body is not acted upon by the digestive secretions and decomposes or ferments, especially when acted upon in the intestines by putrefactive anærobes.

Of the substances which are normally formed and which if retained would produce auto-intoxication, carbonic acid is one of the most familiar examples. It is a product of metabolism, it is absorbed into the blood, carried to the lungs and oxidized, or, if it is retained in the blood and the blood remains unoxidized, auto-intoxication from its influence is the result. Urea is another product of metabolism which it is the function of the kidneys to excrete with the urine. If the kidney function is inefficient and enough of the urea is retained within the blood, convulsions, coma and death will be the result of the auto-intoxication.

Bacterial fermentations, including the familiar yeast fermentation, have as their products alcohol and such acids as lactic, formic, butric, acetic and succinic. These are carbo-hydrate fermentations which usually take place in the stomach and small intestine and with them may come both absorption and the formation of gases in the stomach and intestines, also well-known and very common gastric and general disorders.

The proteid fermentations usually take place from the undigested material which has accumulated in the large intestine, yielding mercaptans, amido-acids and aromatic bodies like indol, phenyl and skatol. These may be absorbed and perhaps changed and eliminated, or, if they are carried into the blood in excess, may produce auto-intoxication.

The body may be protected from the bad effect of these poisonous products by chemical changes which they undergo while passing

through the liver or by the action of antibodies which are present in the blood to destroy them and which may even be increased in numbers and consequently in anti-toxic action by the presence of these poisonous substances. Sometimes great harm comes to the liver while it is attempting to dispose of these substances and this result may not only follow from proteid decomposition but from the injudicious use of anæsthetics, causing an inhibition of metabolism and incomplete combustion of fats.

Auto-intoxication is very apt to occur with such diseases as chronic nephritis, cholangitis, gall-stones, hepatic cancer, with some forms of appendicitis and in connection with intestinal parasites. It is also present in diabetes, pernicious anæmia, myxœdema, acromegaly, Addison's disease and gout. It is the very common condition with those who consume more proteid food than their metabolic capacity will dispose of. With such people the characteristic symptoms are persistent frontal headache, muddy or sallow complexion, dizziness, nausea, a constant feeling of inertness, constipation alternating with diarrhœa, flatulence, indigestion, insomnia, melancholia and many other things that are distressing. In treating this condition it is especially necessary to insist on simple diet with little proteid, plenty of milk and a minimum of sugar and fat.

AUTO SUGGESTION. See HYPNOTISM.

AUTOCHTHONES, a Greek word equivalent to the more familiar Latin "*indigenæ*," meaning the aboriginal inhabitants of a country. It was especially applied to the ancient Athenians by themselves, to distinguish themselves from later immigrants or their descendants, with much the same pride that an American points to his descent from pre-revolutionary stock. The word is frequently used in English as a synonym of "aborigine."

AUTOCHTHONOUS, a term in botany, zoology and palæontology used to indicate such plants, animals or fossils as are indigenous to the places where they are found. The term is opposed to "naturalized," which indicates that the plants, etc., are not indigenous to the places where they are found but have been transferred thither by some agency.

AUTOCRACY, a form of government in which power is invested in a single person; a government in which the sovereign unites in himself the legislative and the executive powers of the state, and thus rules uncontrolled. The word is therefore synonymous with supremacy, or uncontrolled authority. Nearly all eastern governments are of this form. Among European rulers the late Tsars of Russia alone bore the title of Autocrat, thus signifying their constitutional absoluteness. The Imperial German government is in many respects autocratic; although the Emperor is not strictly an autocrat, yet the power vested in him is not "derived from the consent of the governed," which is essential in the case of democracy or popular government. Many of the dictators in the republics of Latin-America were real autocrats, having arrogated to themselves the control of all branches of government despite the democratic constitutions which they were supposed to uphold. Kant uses the word autocracy in philosophy, to denote the mastery of the reason over the rebellious propensities — the self-government of the soul. See GOVERNMENT.

AUTOCRAT OF THE BREAKFAST TABLE, The, a noted work by Oliver Wendell Holmes, consisting of imaginary conversations around a boarding-house table. The characters are introduced to the reader as the Autocrat, the Schoolmistress, the Old Gentleman Opposite, the Young Man Called John, the Landlady, the Landlady's Daughter, the Poor Relation and the Divinity Student. It is the most popular of Dr. Holmes' books; and in none of them are his ease of style, his wit, his humor, his kindly sympathy and love of humanity more clearly shown. It was first published serially in the *Atlantic Monthly* in 1857–58 and appeared in book form in 1858.

AUTOGENOUS PLUMBING APPARATUS. The purpose of this apparatus is to provide, by means of the reaction between oil of vitriol, water and zinc, a supply of hydrogen gas, and, after mixing it with air, to burn the mixture at the end of a blowpipe nozzle, and, by means of flexible rubber tubing, apply the flame readily to the work in hand. By its aid lead sheets, pipes, etc., may be joined together by melting the points of junction, without the use of solder or flux. It can also be used for soldering, brazing and annealing; in fact, for any purpose requiring an intense heat locally applied. It consists of a rectangular box divided into two closed compartments. The upper one is an acid chamber, opening at the top, and a pipe connects it with the bottom of the lower compartment. The lower compartment is the zinc and gas chamber, having a pipe near its top to convey the gas generated into a purifier arranged in the space between the upper and lower compartments. This space also contains the opening into the lower compartment, through which the zinc is inserted. The dilute acid runs down the pipe from the upper chamber into and up through the zinc in the lower chamber, in the upper part of which the gas collects, and passes out by a bent pipe into the bottom of the purifier. The purifier is a box intended to collect any drips which may pass over with the gas. From its upper part a pipe conveys the gas to the bottom of a second purifier, filled with water, through which the gas rises and passes to the blowpipe. The water removes any sulphurous acid gas or other impurities that may pass over with the hydrogen gas.

The rear end of the blowpipe is divided into two branches. To one of these the tube conveying the hydrogen is attached, and to the other a tube conveying air driven in by a bellows. The hydrogen and air combine and mix in the blowpipe, and flow out of its nozzle, when the mixture is ignited for application of the flame to the work. Lead sheets may be joined edge to edge or by a lap. In the former case lead straps are melted along the joint to perfect and strengthen it. The apparatus is used when lining pickling vats, covering floors with lead, etc.; also for annealing the serrated wires for friction primers.

In and near the larger cities, where compressed gasses may be bought in portable cylinders, the hydrogen-making apparatus may be dispensed with, and the oxy-hydrogen blowpipe

substituted. In the latter case coal gas or blau-gas may effectively take the place of the pure hydrogen. The gasses from the portable cylinders are very easily conducted to even the most contracted localities by the simple lengthening of the rubber conducting tubes. Consult Clarke, J. W., 'Modern Plumbing Practice' (London 1914).

AUTOGRAPH, an inscription made by hand, but commonly meaning the signature of a person in his own handwriting. Apparently there is nothing in which one's personality is so inherent as in his handwriting, for the law recognizes the fact that one person cannot successfully counterfeit another's autograph. This is probably the reason why the accumulation of autographs of famous men has been one of the favorite pursuits of collectors from the most ancient times. It is recorded that one of the Egyptian Pharoahs paid high prices to the Greeks for the autographs of Sophocles, Euripides and others of their noted countrymen. The Greeks and Romans were also voracious collectors of such souvenirs, one of the Roman emperors having even the autographs of Chinese scholars. In the British Museum there is one collection which was begun as far back as the 14th century. It is an established fact that in the early Middle Ages there were manufactured in Germany books of blank pages which were sold to travelers that they might obtain the signatures of prominent people in other countries. In the British Museum is such an album dated 1554. It is only within comparatively recent times, however, that the collection of autographs has been commercialized. The buying and selling of signatures has become an international industry, or business, in which experts may command very high salaries. The value of an autograph depends, not only on the fame of the writer, but upon the rarity of his autographs and its condition. Naturally, if it is accompanied by a letter also in his handwriting, the value is many times increased. The most valuable collection of American autographs is in the New York Public Library; it includes the best set of the signers of the Constitution, among which is the autograph of Thomas Lynch, which once brought $5,000 at a sale. Among the most high-priced autographs are those of Raphael, the younger Bach, Charlotte Corday, Sir Francis Drake, Thomas More and Milton. Of the signers of the Constitution the rarest autographs are those of Lynch, Gwinnett, Hart, Morton, Heywood and Middleton. It is estimated that a set of autograph letters of the signers of the Constitution in good condition would be worth about $25,000.

AUTOLYCUS, a Greek mathematician and astronomer of Pitane in Æolia, who lived about 330 B.C., the author of two extant works on astronomy; one on the revolution of the spheres and the other on the rising and setting of the fixed stars. These works have been translated into Latin by Hultsch (Leipzig 1885).

AUTOLYCUS, character in Shakespeare's 'Winter's Tale' (q.v.), a roguish thief who provides the comedy element in the play. He is obviously suggested by the Autolycus of Greek mythology, the son of Mercury and Philonis, who dwelt on Parnassus and was celebrated as a stealer of cattle.

AUTOMATIC BLOCK SIGNALS. See BLOCK SIGNAL SYSTEM.

AUTOMATIC SPRINKLERS. See FIRE PROTECTION.

AUTOMATISM, in animals the power of movement or of action without any stimulus independent of that arising in the protoplasm of cells and tissues. Thus Descartes regarded animals (other than man) as "automata," and declared that they act independently of any volition or instinctive or intellectual power or faculty; in other words, that their so-called mental acts are involuntary and mechanical — that they may be compared to machines. In physiology while automatism is apparently the result of the internal conditions of the living body, yet strictly speaking, says Loeb, no animal movements are exclusively determined by internal conditions. The co-ordinated character of automatic movements has often been explained by a "centre of co-ordination," which is supposed to keep a kind of police watch on the different elements and see that they move in the right order. "But," he adds, "observations on the lower animals show that the co-ordination of automatic movements is caused by the fact that the element which beats most quickly forces the others to beat in its own rhythm." The swarm-spores of algæ, which possess no ganglion cells, show spontaneity equal to that of animals having ganglion cells, and he concludes that automatism is due to a chemical cause; that is, the pressure or absence of certain ions, or, in other words, to the chemical constitution of the protoplasm. Consult Carpenter, W. B., 'Mental Physiology' (Boston 1891); Loeb, 'Physiology of the Brain' (1901).

AUTOMATON, a mechanical contrivance whose actions are arranged to correspond to those of a human being. Friar Bacon had the reputation of having constructed a brazen head which spoke, and Regiomontanus an iron fly, which, after making the tour of the room, returned to its master. Albertus Magnus is said to have spent 30 years in constructing a human figure which advanced to the door when anyone knocked, opened it and saluted the visitor. In the water-clock presented to Charlemagne by Harun al-Rashid, 12 doors in the dial opened respectively at the hour which they represented; they continued open till noon, when 12 knights issued out on horseback, paraded round the dial, and then returning, shut themselves in again. Camus constructed an ingenious toy for Louis XIV, consisting of a carriage drawn by two horses, containing a little figure of a lady with a coachman and attendants. The coachman cracked his whip, the horses moved their legs naturally, and when the carriage arrived opposite the King's seat it stopped; the page stepped down and opened the door; the lady alighted and presented a petition to Louis. The flute-players, the tambour-player and the wonderful duck of Vaucanson are celebrated for the astonishing ingenuity displayed in their construction. Among the most remarkable automata are the whist-playing and other figures designed by Maskelyne in 1875. Consult Brewster, 'Letters on Natural Magic' (London 1834); Houdin, 'Secrets of Conjur-

ing'; and 'Memoirs of Houdin' (ib. 1891); Ozanam, 'Mathematical Recreations' (ib. 1854).

AUTOMEDON, son of Dioreus, who went to the Trojan War with 10 ships. Later he became the friend and charioteer of Achilles, after whose death he served his son Pyrrhus in the same capacity, as described in Homer's 'Iliad.'

AUTOMEDON, two epigrammatists of ancient Greece. One was a native of Cyzicus, the other was an Ætolian. Except that one is supposed to have lived in the time of Nerva, nothing is known of their lives.

AUTOMOBILE. A vehicle adapted for performing transportation work over ordinary roads by means of an engine forming a structural part of it, or by means of a source of power, such as an electric storage battery, installed within it. Synonymous terms are motor vehicle, self-propelled vehicle, horseless carriage or vehicle, motor car. Terms denoting special varieties are steam vehicle, gasoline vehicle, electric vehicle, motor truck, electric truck and other compound terms of similar general character. The word is now used more commonly as an adjective than as a noun; as a verb it is used in the participle form "automobiling," meaning traveling by means of an automobile, but in this sense "motoring" is preferred.

The history of the origin of the automobile records a large number of attempts at producing vehicles of this class, but not until 1895 did the manufacture of automobiles begin to assume the character of a regular industry. Since then the number of automobiles in use has increased at a rapidly progressive rate. In 1899 the United States had about 3,700, mostly steam carriages and "runabouts," but including perhaps 300 gasoline motor cars and 500 electric carriages, cabs and trucks. In 1903 the number had risen to about 11,000, mostly gasoline motor cars, and in 1916 to 1,200,000, including about 32,000 electric carriages and 13,000 electric trucks.

In France and England there were in 1899 about 3,000 automobiles, nearly all gasoline motor cars, and in 1903 the number in all of Europe was estimated at 28,000. In 1914 the total had reached over 600,000 gasoline motor vehicles, of which nearly one-half were in Great Britain, to which should be added a few thousands of steam carriages, steam trucks and electric vehicles, the latter mostly in Germany. These figures include all vehicles registered, new and old. The yearly production shows a still higher rate of progressivity, but the figures cannot be traced readily or accurately.

France, England and Germany divide the European production in the order named, Austria and Italy following with considerably smaller shares. Other statistics and some historical data are given under AUTOMOBILE INDUSTRY.

By far the larger number of all automobiles in use are employed for the transportation of persons but the percentage used mainly for the transportation of goods is steadily increasing. Classifying by the nature of the power source, a decided majority of all automobiles derive power from an automobile engine, often designated as an "automobile motor," which is an engine of the internal-combustion type (see INTERNAL COMBUSTION ENGINES) and is usually operated with gasoline as the fuel, although less volatile hydrocarbon fluids, such as benzol, alcohol, kerosene and melted naphthalene may be used conditionally, especially benzol, which is employed regularly in Europe for motor trucks and omnibuses. From these facts it follows that the automobile intended for the transportation of persons and driven by means of gasoline burned in an automobile engine is the dominant type. It is to this type that the word automobile is applied without the use of additional qualifying terms. Motor car, car, motor, gasoline car, as well as other terms implying nothing to the contrary, are also usually meant to designate this type only. Gasoline motor trucks and delivery wagons are variations of it, differing mainly in the dimensions of machine parts and in the arrangements of the vehicle bodies for the carrying of loads. Motorcycles (q.v.) would come under the same classification as the dominant type if they had not by common consent, due to their origin and peculiarities as bicycles with a motor equipment, been placed in a separate class. After those mentioned, other varieties of automobiles follow, in point of number of them in use, in this order: Electric trucks and delivery wagons, electric carriages and cabs, steam trucks (mainly in Great Britain), steam carriages.

As at least 95 per cent of all automobiles are operated by means of an internal-combustion engine, burning a fluid hydrocarbon fuel and probably 90 per cent of these are used for the transportation of persons and constitute the dominant type of automobile, there is good reason for the popular usage in accordance with which the word "automobile," when used as a noun, refers to this dominant type only. Going a step further in order to avoid all confusion of terms, the word "automobile" is used in the following only as an adjective, and the dominant type is designated as a motor car, while trucks and wagons of the same general type (using the same type of engine, especially) are mentioned as motor trucks and motor wagons, and all other motor vehicles by their more specific names. The division of the very large subject comes then, so far as mechanical construction is concerned, under the following heads: (1) Motor cars, (2) Motor wagons, (3) Motor trucks, (4) Electric trucks and wagons, (5) Electric carriages, (6) Steam trucks and (7) Steam carriages. But not even this division can be strictly adhered to on account of intermediate construction types and the increasing number of special classes of vehicles in which the purpose and the special equipment adopted for serving it are of greater interest than the automobile mechanism which they share, in the essentials, with many other motor vehicles. Special constructions, among which motor omnibuses (see MOTOR OMNIBUS), fire department vehicles (see FIRE ENGINE), and army vehicles (see ARMY TRANSPORTATION; AUTOMOBILE IN WAR) are the most important, are treated mainly under special captions. Tractors and motor ploughs, while in part an outgrowth of the automobile movement and industry, are treated quite separately under TRACTORS and MOTOR PLOUGHS.

Every motor vehicle manufactured for the

market has so far been made in three structural divisions, (1) the chassis, comprising a frame carrying the whole power equipment, the actuating and control mechanism, the vehicle springs and axles and the wheels; (2) the vehicle body or carriage work, comprising all parts of the structural unit which is mounted upon the chassis frame for the purpose of carrying the load of persons or goods in a suitable manner, and (3) the accessories, comprising a number of detached or readily detachable devices serving secondary purposes. Rubber tires, lamps, speed-recorders, tops, carburetors, lubricators, fenders, motor-starters, air-pumps, lifting-jacks — are commonly mentioned as accessories. But tires, electric lamps, lubricators, carburetors and motor-starters operate in organic connection with the engine or vehicle mechanism as a whole, and the classification is only one of convenience to indicate that these units are often manufactured separately.

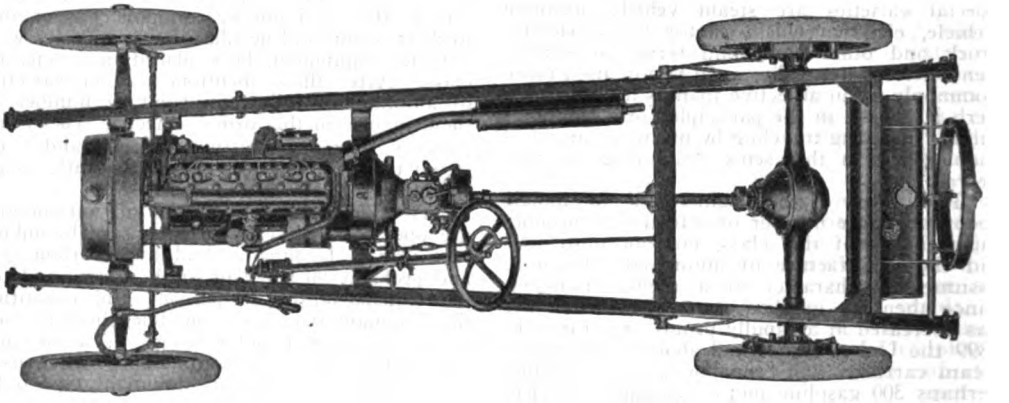


FIG. 1.— Chassis (1917) for light-weight 6-cylinder Motor Car. Frame reaches straight and converging. Springs directly under them. No torsion rods or driving-struts. Running-boards and fenders omitted.

Motor Cars.— The motor car chassis (Figs. 1 and 2) comprises a frame, a power equipment, means for power transmission from engine to road wheels, axles, vehicle springs, means for transmitting a driving-thrust from the road wheels to the vehicle frame, a steering gear, a system of brakes, road wheels and tires. In nearly all motor cars the means for transmitting power from the engine to road wheels are purely mechanical, but in a minority these means are electrical. In a still smaller minority of cases they are hydraulic, which, however, is only a special form of mechanical transmission. Nearly all engines are kept from reaching inadmissible temperatures by the circulation of water which in turn is cooled by air, but in some instances the engine is cooled directly by air. In nearly all motor cars the engine power is transmitted to the rear road wheels only, and the front road wheels are rotated by the push from the rear wheels against the vehicle frame and are utilized for steering, but in a few instances the front wheels are driven from the engine and steered as well, or all four wheels are driven and steered. These variations in construction are indicated when a motor car is referred to as a "gas-electric" car, a "hydraulic-transmission" car or truck, an "air-cooled" car, a "front-drive" car, cab or truck, a "four-wheel-drive" vehicle.

The Frame.— The motor car frame has been developed from a rectangular sash made by riveting industrial angle iron side members to transverse angle iron girders or from a wooden frame of the same simple conformation. The arrangements and proportions of the vehicle body, springs, fenders and even of the power equipment and transmission elements were made to suit this form. The modern frame began its evolution when, about the year 1900, large strips of sheet steel were first shaped for this purpose in hydraulic presses. By degrees it has become practicable to bend the sheet steel in all three directions. Nearly all the side reaches of frames are of [section. Most of the frames are contracted at the front to allow a large turning angle for the front wheels and many are also bent upward at the rear to make room for spring and axle movements. Recently, by using straight but converging side members, as in Fig. 1, cost is saved and such frames readily meet varying design requirements by compromise. Large vehicle manufacturers, however, have the frames designed throughout to suit the rest of their construction after the latter has been determined. In a few instances steps and running-boards are incorporated in the frame to strengthen it without adding weight. Practically all frames are now hot-pressed and hot-riveted. The riveting formerly done by a hammering process is now often accomplished by pressure, with less noise and more rapidly. The strength of the frames depends not only on design and dimensions, but largely upon the skillful shaping of the dies in which they are hydraulically pressed.

The Power Equipment.— The arrangements for fuel supply, the automobile engine and the means for starting and controlling the engine constitute the power equipment. The fuel tank, made of sheet copper or plated sheet steel, is either suspended at the rear end of the frame (Figs. 1 and 2) or supported over a transverse member of the frame underneath the driver's seat. In the first case its position is low, and a light pressure is maintained over the fuel in the tank by means of a small air pump operated optionally from the engine or by hand, in order to make sure that the fuel will be piped to the engine as needed in whatever position the car stands or moves. In the other case the fuel is fed naturally by gravity from the tank to the float-chamber of the carburetor, but the flow

is less active when the car goes uphill than when it moves on the level or downhill. To combine the advantages of both methods, a system is now frequently used by which a small

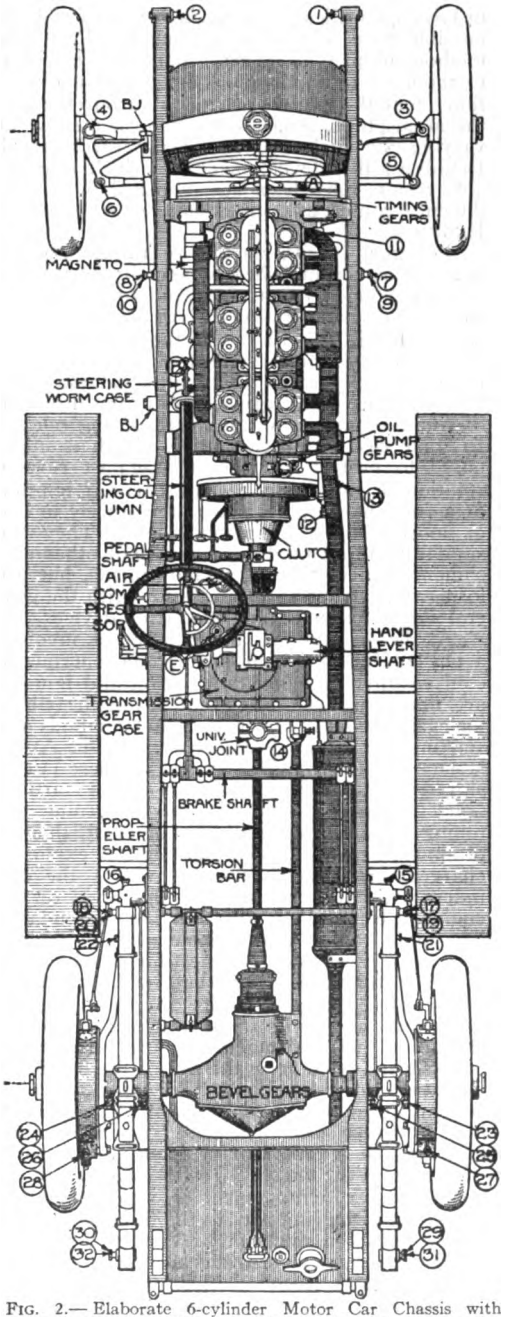


FIG. 2.— Elaborate 6-cylinder Motor Car Chassis with running-boards. Fenders omitted. Numerals and inscriptions indicate parts requiring lubrication.

auxiliary tank is placed near the engine and higher than the carburetor, supplying the latter by a gravity flow with practically unvarying head of pressure while the auxiliary tank is supplied from the main tank at the rear by suction from the intake manifold of the engine. Fig. 3 shows the latter arrangement. Formerly pressure above the fluid in the main tank at the rear was often maintained by piping a portion of the exhaust gas from the engine into the tank. The fuel piping should have few joints, no sharp downward or upward bends where impurities may settle or air bubbles may lodge. The automobile engine may be considered as a development of the gas engine, which was the first internal-combustion engine, so called, when it made its first appearance, to distinguish its nature from that of steam engines. The fuel is burned inside of the cylinders which are utilized for transforming the expansion of gases into mechanical movement, instead of outside of them. Gas engines, stationary and marine hydrocarbon (gasoline or oil) engines, Diesel engines and automobile engines are the four large varieties of the internal-combustion type and each of them has characteristics which overshadow their similarity on the point mentioned. In France and Germany the automobile engine is rarely mentioned as an internal-combustion engine, this distinction from steam engines being apparently considered superfluous.

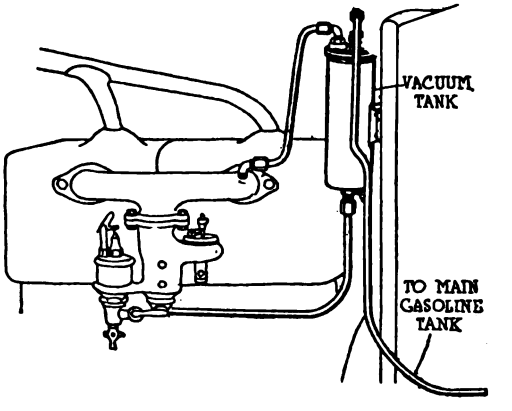


FIG. 3.— Fuel Feed by "vacuum" Relay Tank near and above Engine.

The German term *Verbrennungsmaschine* is a simplification. The term "explosion engine" (French: *Moteur à explosion*), an equivalent for internal-combustion engine, is now seldom used. (See INTERNAL-COMBUSTION ENGINE; GAS ENGINE; DIESEL ENGINE; AUTOMOBILE ENGINE). The typical automobile engine is operated with gasoline as fuel, the equivalent of which is called petrol (pet-rol) in Great Britain, *Benzin* in Germany and *essence de pétrole* (or more commonly *essence* only) in France.

It has four cylinders usually bored in a single iron casting and is bolted to an aluminum crank casing and mounted to stand lengthwise and upright in the front portion of the automobile frame. Four pistons connect by "connecting-rods," without crossheads, with a crankshaft machined from a single drop-forging. It draws a spray of fuel, fuel-vapor and air through a carburetor (q.v.) by means of the suction caused by downward strokes of the pistons, admits the mixture to the cylinders by poppet valves which are opened mechanically and closed by valve springs, ignites the mixture with a spark generated by means of a magneto (q.v.) or other electrical machine at the in-

terior terminals of a spark plug (or «sparking plug») screwed into the head of each cylinder, expels burnt gases by poppet valves which are opened mechanically and closed by springs. It has one camshaft geared to open, and hold open, both intake and exhaust valves at the proper periods. It detonates and burns an explosive gas mixture at every fourth piston stroke in each cylinder. The rear end of the crankshaft carries a small flywheel which is arranged to be used as one member of the coupling between the engine and the power transmission mechanism, and to which is also frequently applied the effort by which the engine is started, unless this is done by hand power by applying a crank to the front end of the crankshaft. The upper portion of each cylinder is cast with hollow walls forming a water jacket, and the water jackets are placed in a water circulation circuit by piping to the upper and lower portions of a «radiator» which is mounted upright and transversely at the front end of the automobile frame. Between the radiator and the camshaft gearing, in front of the foremost cylinder, a rotary fan is operated by gearing or belting to increase the flow of air in the interstices of the radiator structure. A centrifugal pump gear-driven in the lower branch of the water circuit often assists in effecting the circulation. External piping gathers the exhaust from the cylinders and is continued rearward underneath the frame, supported at an intermediate point in a muffler or silencer where the flow of hot exhaust gases, already cooled somewhat on the way, is further baffled and cooled before it is allowed to reach the atmosphere. Of the descriptive statements here made not a single one holds true for all automobile engines. Those which come nearest to representing universal practice refer to the use of a carburetor operated by suction from the engine and to the ignition of the fuel mixture by means of an electrically generated spark. The world-wide demand for an automobile engine in which liquid fuels less volatile and costly than gasoline may be used with equal facility already foreshadows the eventual disappearance of the carburetor operated by engine suction, a more positive and more accurately predetermined preliminary action upon the less volatile fuels being required to make them readily inflammable in the cylinders when the engine is cold and under other adverse conditions of operation, as are bound to obtain in practice occasionally.

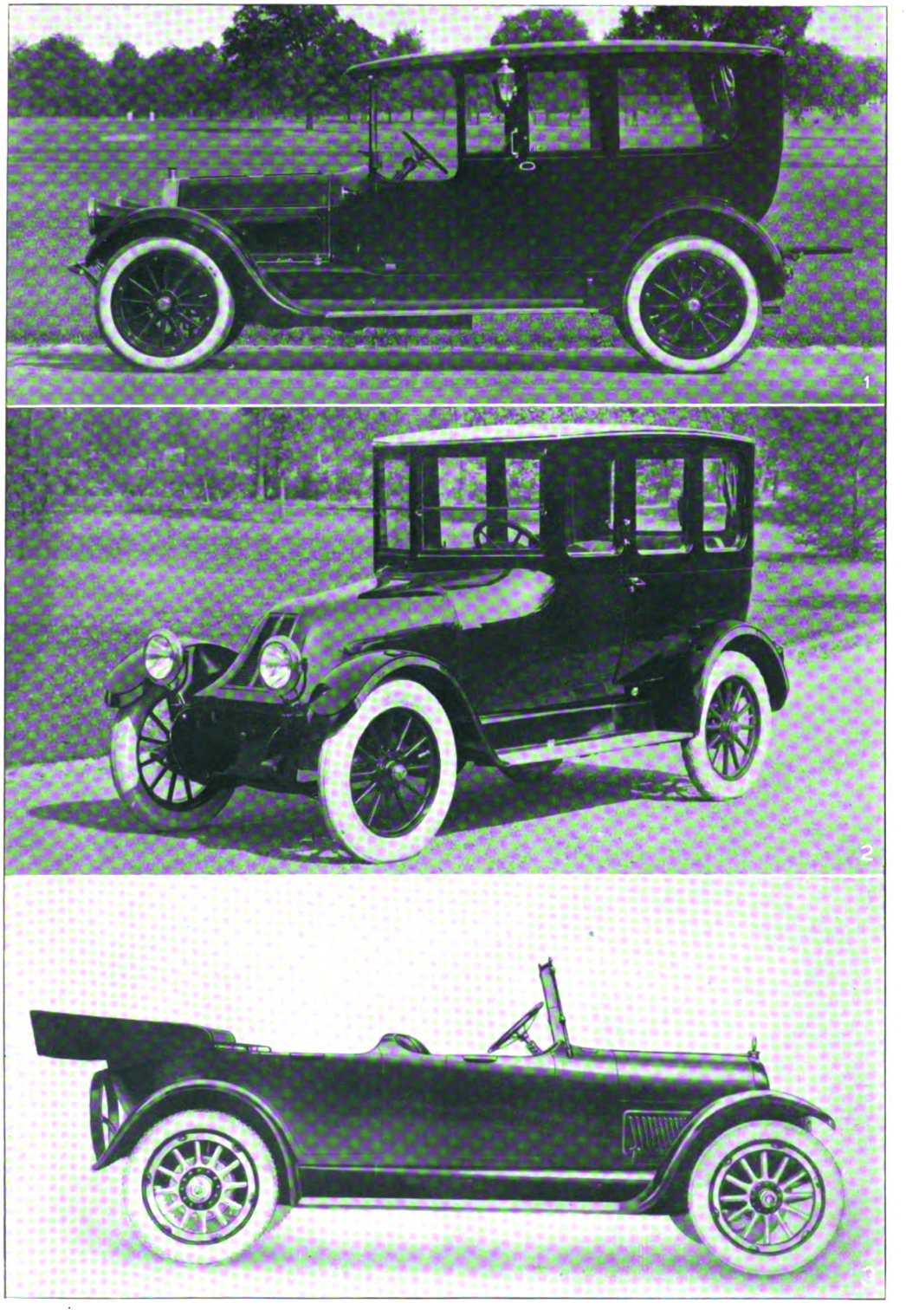
Fig. 4 shows a typical automobile engine equipment. With regard to the very numerous variations in design and details of construction see AUTOMOBILE ENGINE; AEROPLANE; MOTOR BOAT.

The equipment for the starting and control of automobile engines has undergone a continuous development; the control mostly through the improvement of carburetors, the starting mainly since 1910 and in conjunction with the gradual adoption of electric lighting for automobiles, the practicability of electric lighting for vehicles being in turn determined by the perfecting of Tungsten filaments for electric incandescent lamps, as the older filaments were unable to withstand shocks and vibration long enough. The improvement of carburetors has had three main objects: To obtain the best and most economical mixture at all degrees of throttling, to permit the use of benzol and of the gasoline of higher specific gravity which in the course of the years has become the only kind available in large quantities in the market, and to make it possible to accelerate an engine rapidly. The method adopted has been singularly restricted to modifying the channels through which suction from the engine reaches a carburetor and the atmosphere, separate mechanical means for varying the fuel feed rate being rarely tried. Details of this development, by which remarkable results have been accomplished by a very difficult route, are given under AUTOMOBILE ENGINE.

For many years, starting of the automobile engine was accomplished universally by turning a crank applied to the free end of the crankshaft — nearly always at the front of the motor car, and this is still the method employed in cars of limited pretensions to luxurious equipment as well as in most motor wagons and trucks. This crank grips only in one direction of rotation and has an automatic spring release. In some cases a special safety clutch is interposed to protect the operator against reverse rotation of the crank, as may occur if ignition of a fuel charge takes place prematurely in one or more of the engine cylinders. They are similar to those used for hoists and other machinery subject to reverse movements, but are losing importance for automobiles with the general introduction of engine-starter devices.

As the operation of a starting crank involves a physical effort which can become onerous in cold weather or when carburetion and ignition are not in perfect order, and is on the whole inelegant and inconvenient, many methods for starting the engine have been tried (see AUTOMOBILE ENGINE). The simplest of these is employed in practice in conjunction with a starting-crank equipment and consists in turning the timing-lever of the ignition equipment, thereby producing sparks which may ignite explosive charges remaining in one or two of the cylinders after the last previous operation of the engine. But this method is not dependable. The more radical and reliable methods consist in (1) a mechanical connection enabling the driver to turn the engine shaft without leaving his seat, (2) arrangements for storing compressed air and by its release turning the crankshaft, and (3) arrangements for turning the crankshaft (often from the rim of the flywheel) by means of a small electric motor receiving current from an electric storage battery which has previously been charged from the engine by means of a generator or from an independent source of current. The compressed-air engine-starter arrangement is used mostly in France but is giving way to the electric method. Fig. 5 shows a diagram of one of the many electrical arrangements, which additionally supply current for electric lamps.

Power Transmission.— The typical mechanical power transmission mechanism of a motor car comprises the clutch, the gearset, the drive shaft with universal joints, a bevel gear and a differential gear mounted at the middle of the rear axle and keyed to wheelshafts which are again keyed at their outer ends to the hubs of the road wheels. A transmission set less used



1 Modern Type American Limousine

2 Light car with Sedan Body

3 Touring Car

for motor cars but more for motor wagons and trucks comprises the clutch, the gearset, the bevel gear and differential on a transverse countershaft near the middle of the vehicle, a

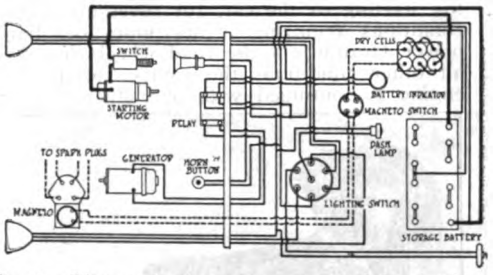


FIG. 5.— Diagram showing an arrangement of electric wiring for obtaining ignition of fuel charges, lighting of vehicle by incandescent lamps, operation of electric alarms and starting of the engine by the co-ordinated operation of a generator, a magneto, a storage battery and a dry cell battery.

sprocket pinion at each end of the countershaft, a chain from each pinion to a sprocket wheel on each road wheel. In motor trucks a worm gearset often takes the place of the bevel gearset, being better adapted for effecting a large reduction of the rotary speed of the wheel-shafts, while less suitable for motor cars, causing more resistance against coasting and other movements of the vehicle for which engine power is not applied. Other variations, known as internal gear drive and compound rear axle gear reduction, are referred to under MOTOR TRUCKS. All other methods for transmitting the power are exceptional.

The clutch may be of the friction cone type, the brake type or the plate type, the latter having few or many plates which may be lubricated

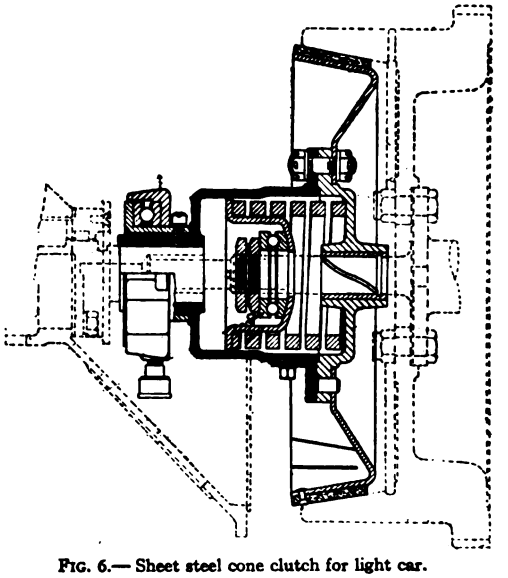


FIG. 6.— Sheet steel cone clutch for light car.

or dry. Types rarely employed are the hydraulic and the pneumatic.

Fig. 6 shows a cone clutch arranged to centre itself automatically in the flywheel.

The brake type, which is rare, is similar to rear wheel brakes, comprising either two semi-circular segments arranged to be expanded against the flywheel rim or a steel band contractible on a drum secured to the face of the flywheel. It is mostly used in Europe, especially in German cars.

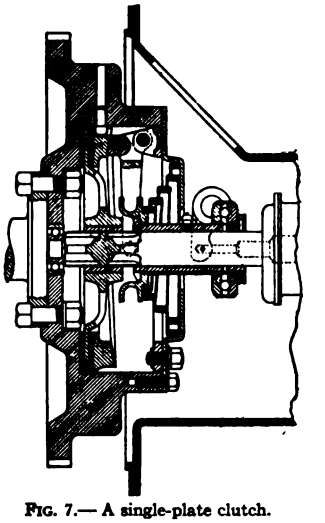


FIG. 7.— A single-plate clutch.

Fig. 7 shows a plate clutch with one plate. Fig. 8 one with many, half of which are secured to rotate with the flywheel of the engine and the alternate ones with the clutch shaft. The plates in clutches operating without lubricant

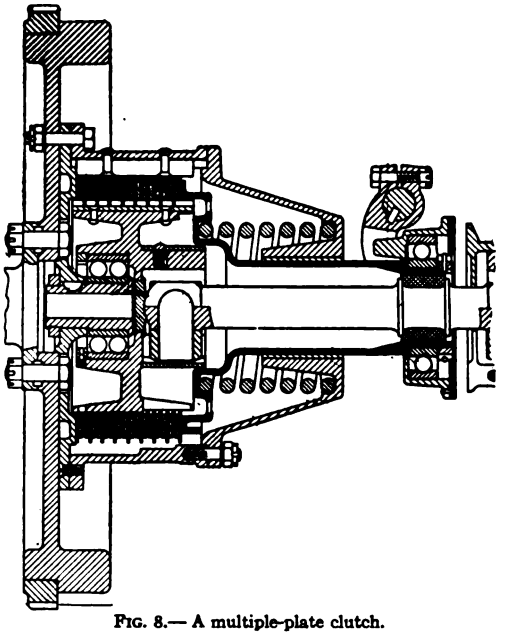


FIG. 8.— A multiple-plate clutch.

are generally made of other materials than steel or bronze, or alternate plates are of metal and the intervening plates of composition material.

Frequently the clutch as well as the gearset is so encased as to form a rigid unit with the

engine (Fig. 9), and the enlarged "unit power plant" so formed is then often mounted in the automobile frame with support at only three

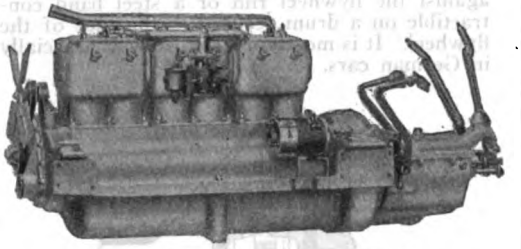


FIG. 9.— A six-cylinder unit power plant.

points (or four points of which two are very close together), with the object of preventing any twisting or other deformation of the frame,

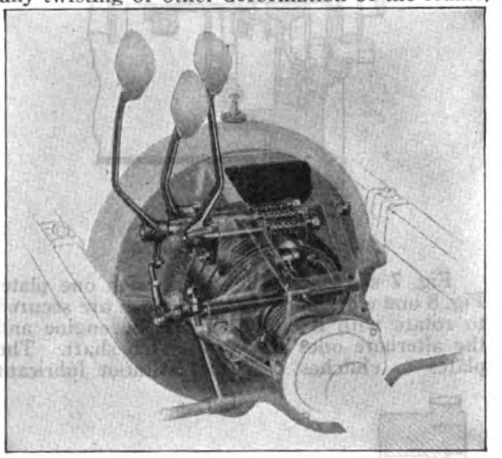


FIG. 10.— Transmission showing operation of clutch, reverse and brake pedals.

which may be caused by the roughness of roads, from reaching and affecting the alignment of engine, clutch and gear shafts. If this means

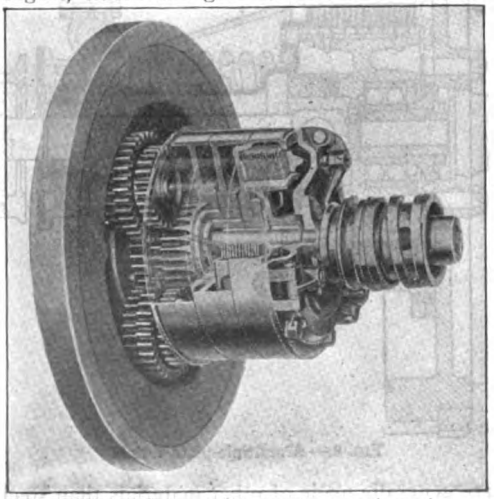


FIG. 11.— Transmission showing gears in mesh.

(also serving to exclude dust) is not adopted, a universal joint is interposed between the clutch and the gearbox.

Figs. 10, 11 and 12 show the unit power plant and the equivalent for clutch and gearset used in the most popular small motor car construction. It operates with a planetary gear and provides one radical gear reduction for use at the starting of the car, for reversing and for conditions requiring a maximum of driving power (torque) at the road wheel rims. For all other conditions the rotary speed of the engine is continued without reduction to the

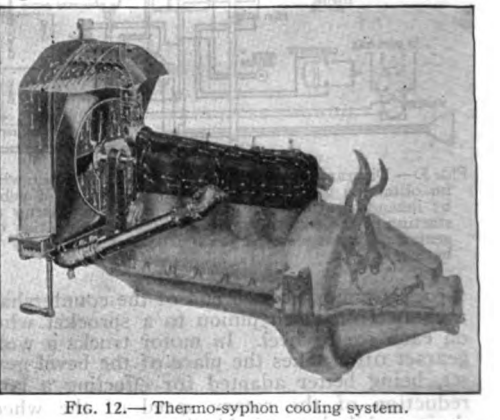


FIG. 12.— Thermo-syphon cooling system.

bevel gear on the rear axle, where it is reduced in the proportion of one to four, approximately. With this important exception the typical gearset follows more or less closely the design shown in Fig. 13, representing a gearbox (and clutch) with three forward gearspeeds and a reverse. For many large motor cars and heavy motor trucks four forward gearspeeds are used.

The methods by which gears are shifted have undergone considerable change in recent years. The shifting lever and quadrant which were formerly on the outside of the motor car body are now inside of it as shown in Fig. 14, the change being a result of the general adoption of "left side drive," or changing the driver's

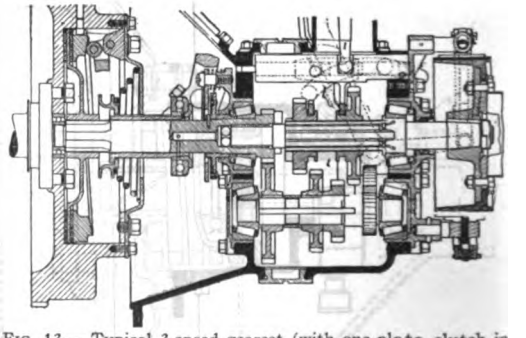


FIG. 13.— Typical 3-speed gearset (with one-plate clutch in front and transmission brake at the rear). Operating levers, at top, shown in part only.

seat from the right to the left side of the vehicle. A long development in control of gear-shifting, from "progressive" to "selective" is described in most books on the subject but is passing into the remoter sphere of mechanical history. Similarly the gradual improvement in shifting forks and jaw clutches in the gearbox. A very recent development is a construction by which all gear wheels remain in mesh, excepting the reverse, the main object being to reduce

the amount of skill required for smooth and silent operation, all clash of gear wheels being avoided. The latest omnibuses in Paris are equipped with gearboxes of this type.

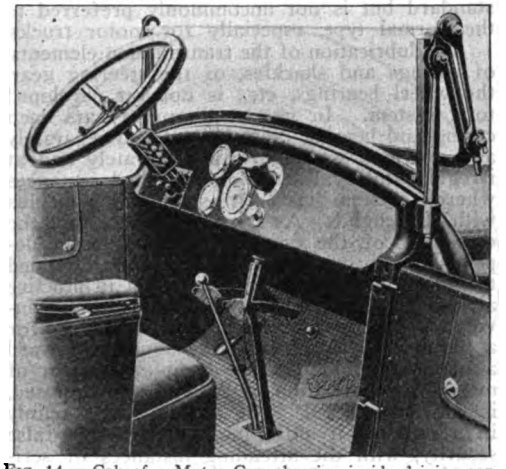


FIG. 14.— Cab of a Motor Car, showing inside driving control ("left side drive") and the Instrument Board.

To have spur gears operate silently the first requirement is the accurate involute cut of the gear teeth, perfected by grinding and polish, and great improvement in milling machines has been necessary to effect the smooth running and small wear of the gears with which the motoring public is now familiar. Another requirement relates to the circumferential speed

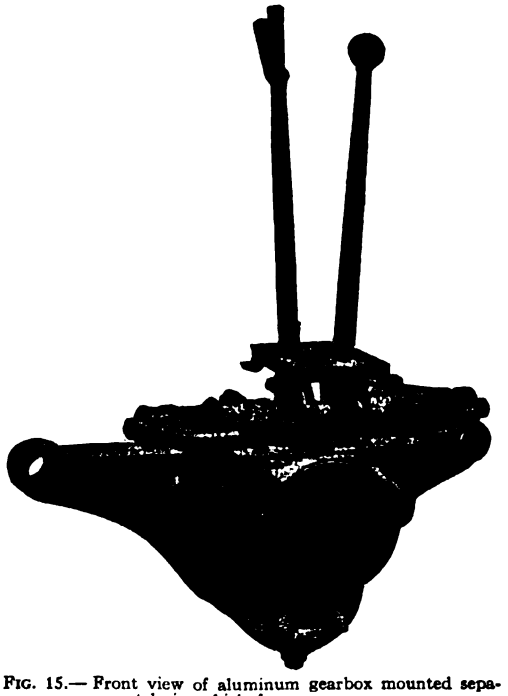


FIG. 15.— Front view of aluminum gearbox mounted separately in vehicle frame.

of the gear wheels, which should be as small as possible to reduce the humming noise of the mesh. To reduce the diameters of the gears accordingly and yet have the teeth (whose dimensions are reduced in the same proportion) strong enough, the use of very strong alloy steel in gears has been necessary, calling for a specific development of metallurgical science and the exercise of painstaking judgment. For, if the gear teeth are made too small, the pressure upon lubricants becomes so large as to squeeze them out, thereby increasing friction and wear, and if the teeth are broadened to avoid this consequence the movements of the shifting forks needed for changing gear become larger than desirable, the gearbox longer and heavier, the shafts more subject to vibration.

Mainly in England the use of silent chains (q.v.) in gearboxes has been resorted to for overcoming these difficulties. Resonance of the aluminum box containing the gears is also to be avoided, so the material is thickened and the shaft bearings in its walls are made as long and large, to postpone wear and looseness, as other dimensions permit. The exterior of an

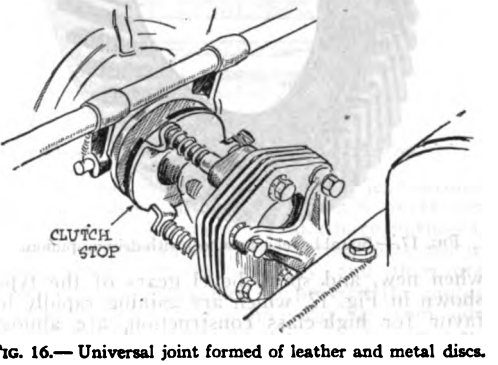


FIG. 16.— Universal joint formed of leather and metal discs.

aluminum gearbox mounted separately in the frame is shown in front view in Fig. 15.

The relations existing in the matters of fuel economy, gear speeds and gear ratio, convenience in driving, vehicle weight, the special qualities of the engine which are indicated by its power and torque curves, form a subject on which the opinions of engineers differ, not so much with regard to the mechanical results of a given set of conditions as with regard to the question of what results are most desirable. The answer varies greatly with the purpose of the vehicle. And thus a great variety of engines are in use, weighing from 15 down to five pounds per horse-power, having a maximum speed from 800 up to 4,000 revolutions per minute and from one to 12 cylinders. The gearbox arrangements vary accordingly. As a rule, the larger the range and resources of the engine, the smaller and simpler the gearbox can be, for given working conditions.

Universal joints, drive shafts, bevel gears and differential gears, of which typical examples are included in preceding illustrations, are mechanical units known in many applications outside of motor cars, but in these they reach their most refined development. Universal joints formed of leather disks on the plan shown in Fig. 16 have been widely tried, with the object of securing silence and avoiding lubrication and wear, as well as the exuding of oil or grease liable to occur in these members if they are entirely metallic, but these substitute arrangements have not proved durable or adapted for

manufacture on a large scale and are now seldom used.

Bevel gears have been so refined that their mechanical efficiency reaches 95 to 96 per cent

FIG. 17.— Spiral bevel gear wheel with driving-pinion.

when new, and spiral bevel gears of the type shown in Fig. 17, which are gaining rapidly in favor for high-class construction, are almost silent in operation.

The differential (typical bevel gear with differential, Fig. 18), whose function is to allow one driving wheel to rotate more rapidly than the other, as is necessary when the motor car turns, causes an unsuitable action when one of the driving wheels is in a slippery place in the road, so that it can be spun around rapidly with less resistance than required for starting its mate. The engine then drives this wheel alone and traction is lost. A remedy used little for motor cars but widely for motor trucks — and obligatory for European army trucks — consists in a locking device by which the differential can be made inoperative. To accomplish the same purpose more completely

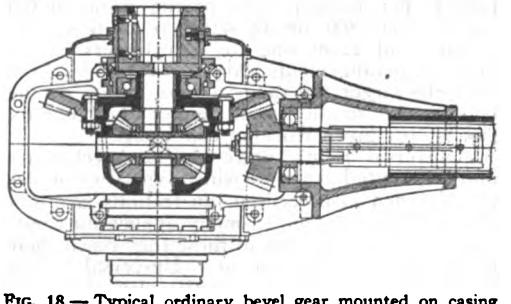


FIG. 18.— Typical ordinary bevel gear mounted on casing of differential gear.

and conveniently, differential gears have been invented in which the differentiating movement is braked by hydraulic or mechanical friction or arranged with helical gears whose diameters and pitch are so chosen that they can be operated in one direction but much less readily in the other. Fig. 19 shows a sketch of a differential of this nature which is not yet standard but is not uncommonly preferred to the normal type, especially for motor trucks.

The lubrication of the transmission elements, of springs and shackles, of the steering gear, the wheel bearings, etc., is not yet developed to a system. In nearly all motor cars each casing and bearing must be watched separately and provided with lubricant separately and at irregular intervals. In the isolated instances where a system has been established, it begins with the engine. As it is recognized that the durability of the mechanical construction depends greatly upon having lubrication attended to unfailingly, and as constant (but in practice always irregular) attention to lubricating involves a large share in the work of caring for a motor car, a universal development toward an almost automatic and complete system of motor car lubrication, now barely inaugurated, is widely expected. The difficulties lie mainly in rendering it unfailing, so that no false security, with the attending instances of serious damage to parts, may be the result.

While the worm gear sets and internal-gear drives are occasionally used for motor cars, their use for motor trucks and electric vehicles is more common.

Transmission by chain drive from a countershaft is typical for motor wagons and motor trucks and is referred to under these heads below, but it is also still used in a few high-speed motor cars, especially in Germany, having survived from the time, before 1905, when it was the most widely used transmission system for motor vehicles of all classes. It does not differ in principle from the chain drive used for bicycles.

Electric transmission from an automobile engine has been frequently tried for motor cars and motor trucks but has never gained adoption for regular and extensive manufacture. As it admits of dispensing with the shifting of gears and can easily be adapted to the driving of all four wheels, however, it is constantly taken up again, in one place or another, when developments or discoveries in electric science or machinery seem to promise new and superior results. As the features of greatest special interest in these vehicles are electrical and no type of motor car or motor truck with electric transmission is yet widely established industrially, descriptions of the most recently developed systems of this order (represented in the United States by the Entz transmission, in England by the gas-electric omnibuses operated mainly in Manchester, and on the continent by the Balachowski & Caire gas-electric trucks) are given under ELECTRIC VEHICLES.

Hydraulic transmissions exist sporadically in experimental motor cars and are used in a few motor truck constructions, such as the Manly (American-La France) in the United States, the Hele-Shaw in England, the Hugo Lentz in Germany and France, and the improved Janney-Williams (Delaunay-Belleville) in France. As they are not yet important in the automobile industry and the principles employed in them are similar to those applied more extensively and typically for hydraulic marine steering gears and other hydraulic machinery,

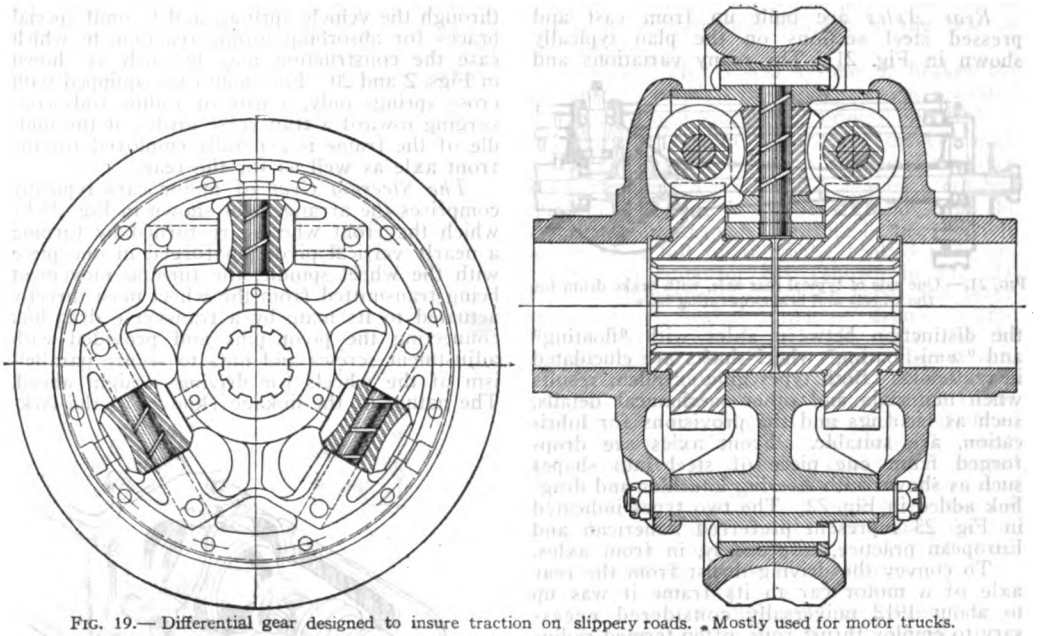


FIG. 19.— Differential gear designed to insure traction on slippery roads. Mostly used for motor trucks.

descriptions or explanations of hydraulic motor vehicle transmissions are given under HYDRAULIC MACHINES.

Vehicle Springs.— No adequate understanding of the requirements in vehicle springs for motor cars can be gained without a comprehensive study including not only spring materials and spring design but also the relations of the spring action to the auxiliary action obtained from resilient wheel tires, to the length of the wheelbase of the vehicle (the distance between axles), to the distribution of weight between axles, to the average and maximum speeds required of the car, to the nature of the roads over which it is most likely to travel and to several minor factors. On the whole experimentation has dictated the development, and all "springing" is a compromise among more or less conflicting requirements. As the object of "springing" in general is to permit the wheels and axles to bounce over the inequalities of a road surface without communicating severe shocks or much up-and-down movement to the vehicle frame and body, and the springs for this purpose should be as flexible as practicable, and as, on the other hand, very flexible springs oscillate with great amplitude after a shock, and such oscillations in turn are liable to react upon the frame and body, the technical effort in spring design is largely concentrated upon the problem of moderating the rebounds and oscillations of vehicle springs which are flexible and lively. Flexibility, life and strength are combined in the springs by using special alloy steel for the spring leaves, by having each spring made of many thin leaves rather than a smaller number of thick ones (this permitting a reduction of their length) and often by using springs which do not only bend but also rock around a pivot near their middle (cantilever springs). The nature of the cantilever spring, being a type almost exclusively used for motor cars, is illustrated in Fig. 20.

The use of coil springs in lieu of leaf springs has often been attempted but has never yet become general, except for auxiliary purposes, mainly because this type of spring does not in itself possess lateral stability and therefore must be specially braced to prevent the motor car body and frame from swaying from side to side. The means adopted for moderating rebound and oscillations take the form of auxiliary devices which can be coil springs whose periods of oscillation differ from those of the leaf springs and thereby break up the harmonic sequence of movements, but usually they are based on mechanical or hydraulic friction and are called rebound checks or shock

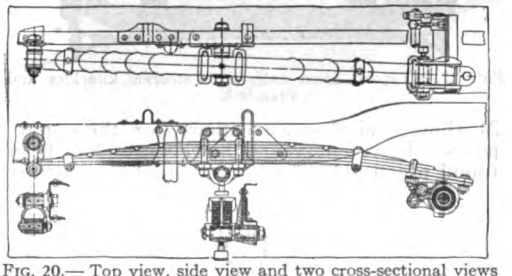


FIG. 20.— Top view, side view and two cross-sectional views of cantilever spring in its relation to a motor car frame.

absorbers. But for motor cars intended for speeds higher than 20 miles per hour satisfactory results, securing both comfort for occupants and safety for the vehicle structure, are not considered to be obtained without the additional equipment of pneumatic tires for the vehicle wheels.

Most of the elements in the springing of motor cars are also used for other classes of motor vehicles and in part for ordinary horse-drawn carriages and for railway cars and coaches. To avoid repetition more detailed information will therefore be found under VEHICLE SPRINGS; SPRINGS; REBOUND CHECKS; SHOCK ABSORBERS; RUBBER TIRES.

Rear Axles are built up from cast and pressed steel sections on the plan typically shown in Fig. 21. The many variations and

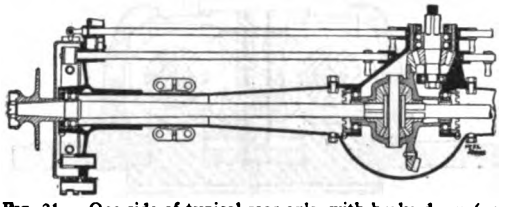


FIG. 21.— One side of typical rear axle, with brake drum (on the wheel) and brake-operating bars.

the distinction between axles with "floating" and "semi-floating" wheel shafts are elucidated in textbooks. Both types give excellent results when materials and other mechanical details, such as bearings and the provisions for lubrication, are suitable. Front axles are drop-forged from one piece of steel into shapes such as shown with steering knuckles and drag-link added in Fig. 22. The two types indicated in Fig. 23 represent preferred American and European practice, respectively, in front axles.

To convey the driving-thrust from the rear axle of a motor car to its frame it was up to about 1912 universally considered necessary to employ thrust rods, often termed radius rods, extending from the axle to some portion of the frame near its middle, and in the power transmission system a detail of kindred nature is a torsion rod or tube serving to prevent the power thrust upon the teeth of bevel gears from skewing the axle and causing uneven riding of the frame and body on the springs. Torsion rods or bars are still generally used, and in many cases the thrust rods and the torsion rods are combined in the form of a tubular casing for the drive shaft, forking into two branches at the front end. Figs. 2 and

FIG. 22.— Typical front axle, with steering knuckles and drag link.

24 show typical constructions for these purposes. In recent years, however, it has been found practicable to transmit the driving effort through the vehicle springs, and to omit special braces for absorbing torque reaction, in which case the construction may be such as shown in Figs. 2 and 20. For small cars equipped with cross springs only, a pair of radius rods converging toward a transverse girder at the middle of the frame is generally employed for the front axle as well as for the rear.

The Steering Gear of motor cars typically comprises the arrangement shown in Fig. 25 by which the front wheels are turned by turning a nearly vertical pivot pin forged in one piece with the wheel spindle, the turning movement being transmitted from the wheel most directly actuated to its mate by a transverse drag-link connecting the pivot pins and provided with adjustment screws and nuts to secure parallelism of the wheels for driving straight ahead. The nature of the linkage (known as the Ack-

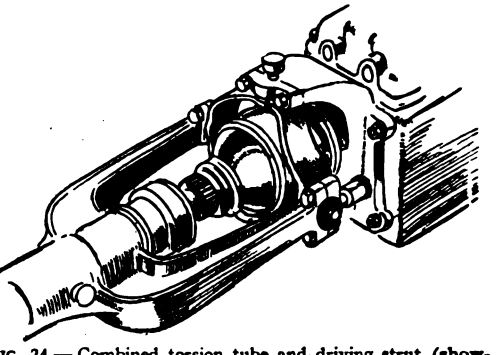


FIG. 24.— Combined torsion tube and driving strut (showing also spherical universal joint and rear end of gearbox).

erman steering system and invented for use with ordinary vehicles more than 100 years ago) causes the wheels to diverge a trifle forwardly when turned — and the more the more they are turned — with the object of making one wheel turn a shorter curve than the other, as required. In some cases the pivot pin is formed upon the axle end and the knuckle in one piece with the wheel spindle. (Fig. 23).

The operating mechanism, as shown in Fig. 25, actuates a wormwheel (or a sector of a wormwheel) by means of a worm with treble or quadruple thread of about 30 to 45 degrees pitch, and the steering arm keyed to the worm-wheel or sector is thereby turned forward or backward, its lower end describing a short

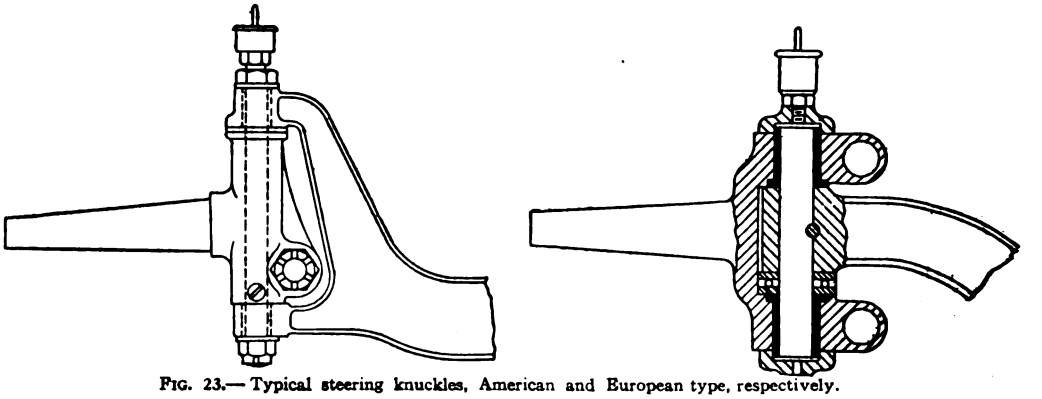


FIG. 23.— Typical steering knuckles, American and European type, respectively.

arc. This end is jointed as in Fig. 26 with the rear end of a lengthwise steering rod whose front end is jointed to a short crank arm on the pivot pin or knuckle. This mechanism is reversible, as the worm and sector are kept well lubricated within the substantial casing enclosing them, and the wheels can readily be turned by applying force against them for that purpose. But in some motor cars, and in a majority of heavy motor trucks and other motor vehicles, a square screwthread takes the place of the worm, and a large nut is moved obliquely up and down to actuate the steering arm. This arrangement is only semi-reversible, or it may be irreversible if the screwthread is of low pitch. Jolts received on the sides of the front wheels on rough roads are with this construction transmitted only in slight degree to the driver's hands, but the violence of stresses to which the mechanism is subjected from wheel rim to steering gear is correspondingly greater. These stresses are absorbed to some extent in the buffer springs with which the joints of the steering rod are provided.

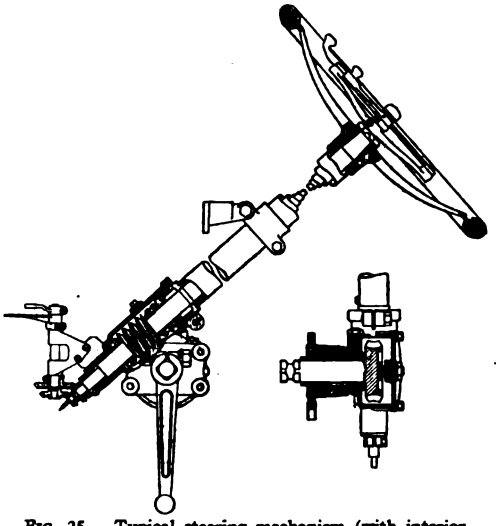


FIG. 25.— Typical steering mechanism (with interior tubes for ignition and carburetor control).

In some types of motor cars and in very many motor trucks the steering linkage is arranged crosswise of the vehicle, which arrangement is modified in several ways and can have the advantage, if the front vehicle springs must be of high camber, that the steering action is then less influenced by oscillations of these springs than when the steering rod runs lengthwise.

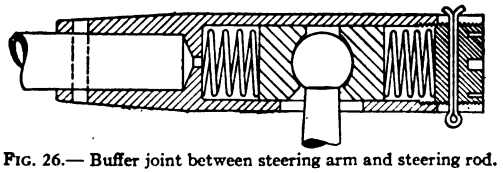


FIG. 26.— Buffer joint between steering arm and steering rod.

Fifth-wheel steering, as standardized for vehicles drawn by animals, is scarcely ever used for motor vehicles of any class, excepting only a few, mostly electric, in which a forecarriage containing the whole power mechanism forms a separate unit coupled to the rest of the vehicle.

Brakes.— The typical system of brakes for motor cars consists of service brakes operated by a pedal and emergency brakes operated by a lever at the right side of the driver's seat. The lever can be locked in any position given it by means of a pawl acting against a notched quadrant secured to the car frame, and the emergency brakes can therefore be used to hold a car on a hill unattended. Linked rods, including an equalizer bar (shown in Fig. 2), transmit movements of brake pedal and lever, separately, to brakes acting on drums secured to the driving wheels. Usually (Fig. 27) the service brakes are brake shoes (faced with friction fabric) which are forced by the turning of a cam against the inside of the drum, and the emergency brakes are steel bands lined with special brake-surfacing material, which are contracted by a similar cam action against the outside of the drum. To permit the cooling of the drum, the latter is in some cases widened and the emergency brakes are made like the service brakes and act side by side with them, both sets on the inside of the drums. In many European cars and some American ones, the service brake is single and is mounted upon the transmission as in Fig. 13, usually upon the gear shaft just behind the gearbox and in front of the universal joint connecting with the drive shaft. In connection with this construction, the emergency brakes are expansion brakes in the rear wheel drums. The use of brakes on all four wheels is practised on a few makes of cars in England and occasionally on a racing car, the systems used in each case being described in the larger textbooks on automobile construction. Hydraulic brakes are used for some heavy motor trucks, largely with a view to the operation of such vehicles on long declivities. For motor cars, hydraulic, pneumatic and electric brakes are in a state of development. Patented systems exist for utilizing the engine as a brake by omitting fuel-charging and ignition and making the pistons work against air charges in the cylinders. But these have not been widely adopted, perhaps mainly for not being subject to finely graduated control of the braking effect.

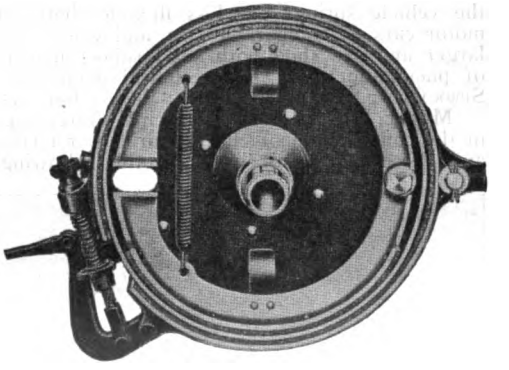


FIG. 27.— Brake drum with service brake interiorly and emergency brake exteriorly.

Wheels.— The wheels of motor cars are either wood wheels or wire wheels, the wood wheel being a development of ordinary vehicle

wheels and the wire wheel of bicycle wheels, and in either case the hub is adapted to be mounted on ball bearings or roller bearings, and the rim is arranged to receive a pneumatic rubber tire. For construction details of wheels, wheel bearings, wheel rims (now usually readily dismountable and called "demountable rims," a corruption of French *démontable*), and pneumatic tires, see WHEELS; BALL BEARINGS; ROLLER BEARINGS; RUBBER TIRES.

Motor Car Bodies.— The technical development and construction of carriage bodies has undergone radical changes in its adaptation to the automobile and to mass-manufacturing methods. Wood, steel and aluminum are all largely used for the framework and panels of the bodies, with a growing preference for sheet metal work. The painting which was at first a laborious and time-consuming art is turned more and more into spraying and dipping processes followed by rapid artificial drying by hot air, taking place while the bodies are carried on conveyor belts from one end of a long building to another, and the atmosphere in the building is carefully filtered to exclude dust. Fenders and engine hoods are often made as specialties at outside factories.

A general view of mechanism and arrangement of an elaborately designed motor car of the "touring car" class is given in Fig. 28.

Motor Wagons.— The chassis of motor wagons are frequently almost identical with chassis made for motor cars of the same manufacture. But large numbers are especially designed for delivery of merchandise and express wagon work, and in many of these chassis power transmission is of the chain-drive type, the vehicle springs are less flexible than for motor cars of comparable size, and wheels are larger and are shod with solid rubber instead of pneumatic tires. For technical details, see SPROCKETS; SPROCKET CHAINS; SILENT CHAINS.

Motor Trucks.— The principal differences in the construction of chassis for motor trucks and those for motor cars are the following, speaking in general and with reference to the preceding account of common motor car construction: The engine is heavier, slower and larger, the maximum engine speed rarely exceeding 1,500 revolutions per minute and frequently not reaching half of that figure. The general type of engine is shown in Fig. 29. Self-starting and electric lighting equipments are usually omitted, though provision is often made for fitting them afterward at the purchaser's option. The frame is usually made of industrial iron shapes but especially designed pressed-steel frames are gradually displacing the cheaper construction. The frame projects from one to three feet in front of the front axle and as far to the rear of the rear axle as necessary for providing load space. In heavy trucks from three-fourths to eight-ninths of the load is carried over the rear axle. (By this system the cost of production can be somewhat reduced, as the front portions of trucks of different load capacities can be made nearly alike, but the better manufacturing practice tends toward providing a complete individual design for each size of truck). As a heavily loaded platform demands a broad support on the vehicle springs, these are generally of the semi-elliptic or platform type at the rear and are often supplemented by overload springs (see VEHICLE SPRINGS) which come into action only when full load is carried or severe shocks are received on the road. Rebound checks and shock absorbers are rarely used. Instead of ball bearings or roller bearings in the wheel hubs, parallel bearings are quite generally used, especially in Europe; in England often with floating bushings and special provisions for keeping lubricant from leaking out. Each rear wheel is usually shod with two solid rubber tires, side by side, known as twin tires; each front wheel with a single solid rubber tire. Pneumatic tires in front or on all four wheels are used only for delicate loads, such as pianos, dynamite, glass, crockery.

The transmission system for motor trucks

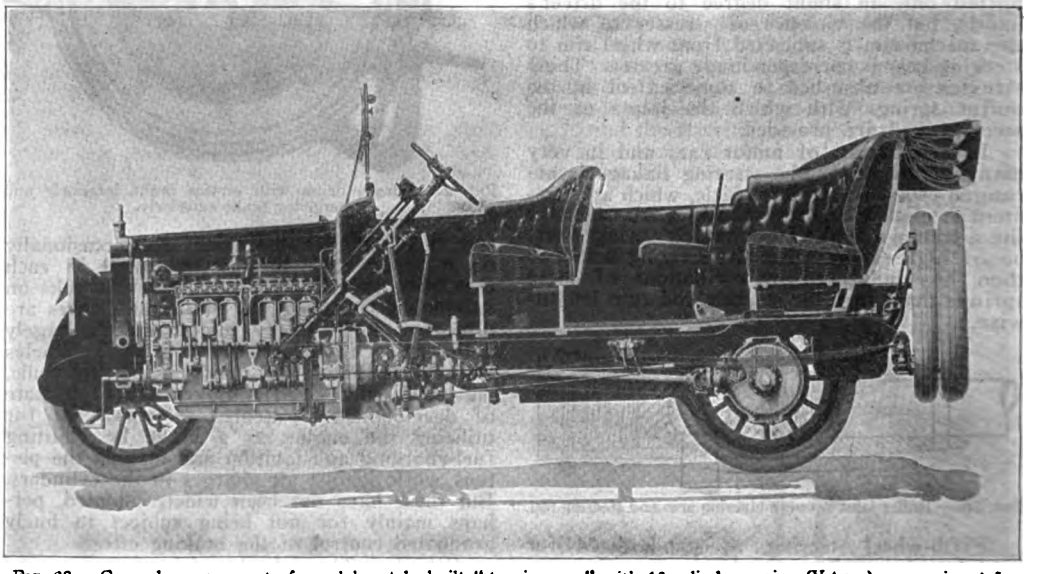


FIG. 28.— General arrangement of an elaborately built "touring car" with 12-cylinder engine (V-type), approximately as it would be shown by a lengthwise cut through the vehicle.

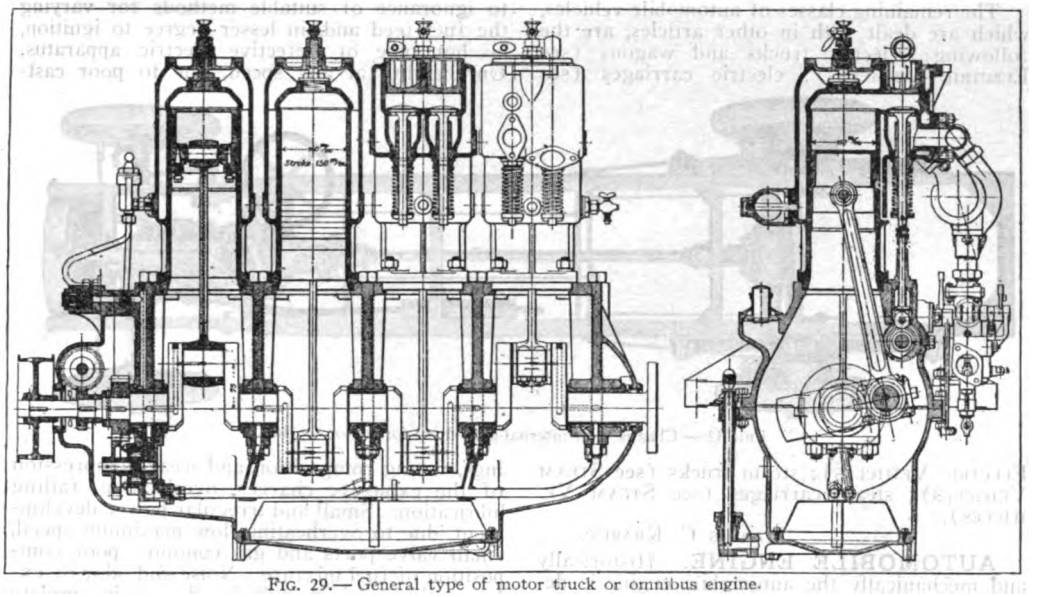


FIG. 29.— General type of motor truck or omnibus engine.

is sometimes the same as that described as typical for motor cars, but recently worm gear sets are taking the place of bevel gear sets, allowing more gear reduction for a given road clearance under the middle of the rear axle and being credited also with silent running and,

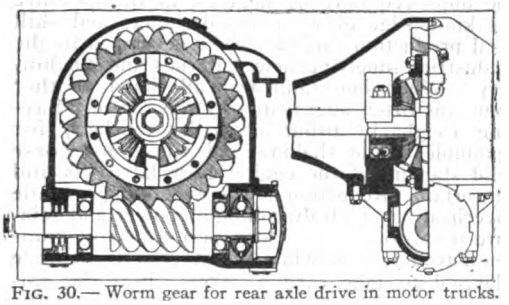


FIG. 30.— Worm gear for rear axle drive in motor trucks.

for heavy work, with greater durability. Fig. 30 shows the nature of a worm gear as used in motor trucks. The worm may be either above or below the worm wheel. Further details are given under GEARS and WORM GEARING. Reliable lubrication, accurate alignment and suitable end-thrust bearings are conditions for the successful use of worm gears in motor vehicle driving systems. A general view of chassis and body arrangements of a motor truck with worm drive is given in Fig. 31.

Another variation of the ordinary shaft drive transmission which is commonly employed in motor trucks is known as the internal-gear drive, of which an example is shown in Fig. 32. A variation less commonly yet not infrequently used is the compound rear axle gear by which two pairs of spur wheels transmit the rotary movement from bevel gear and differential to the wheel shafts within the rear axle housing, in order to effect a reduction of speed. But chain drive, without casing for the chain, is still the type of transmission most numerously represented in this class of vehicles, the general construction of it being the same as for motor wagons. Radius rods for transmitting the driving thrust to the truck frame are always used with this drive and are arranged to be lengthened or shortened by a screwthread adjustment in order to adjust the distance between sprocket wheels and thereby compensate for wear of the chain. Roller chains are generally used. See SPROCKET CHAINS.

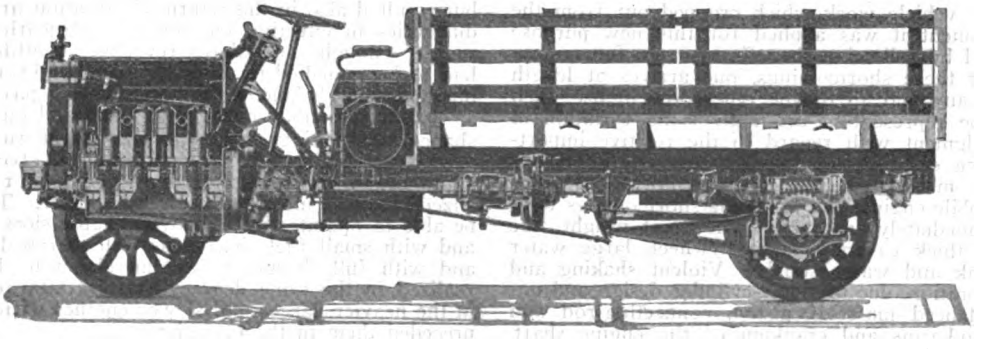


FIG. 31.— Chassis and body arrangements of motor truck with worm drive. Shown as cut through lengthwise.

The remaining classes of automobile vehicles, which are dealt with in other articles, are the following: Electric trucks and wagons (see ELECTRIC VEHICLES); electric carriages (see ELECTRIC VEHICLES); steam trucks (see STEAM VEHICLES); steam carriages (see STEAM VEHICLES).

MARIUS C. KRARUP.

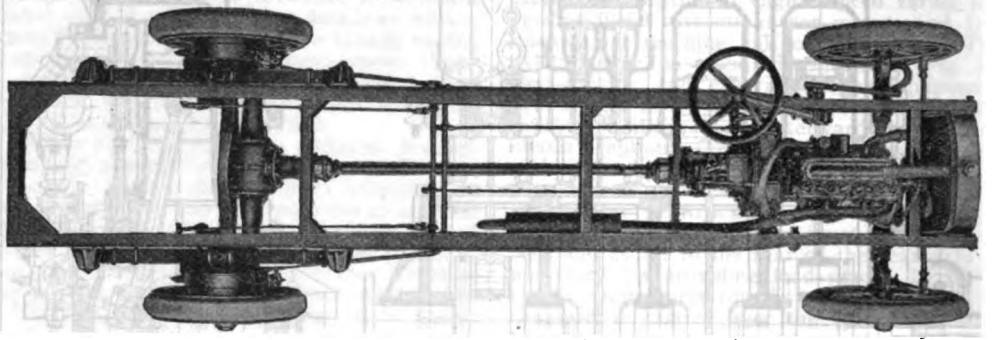


FIG. 32.— Chassis with internal-gear drive for motor truck.

AUTOMOBILE ENGINE. Historically and mechanically the automobile engine is derived from the stationary and marine gasoline engines developed before 1890. (See INTERNAL COMBUSTION ENGINE; GASOLINE ENGINE). These were either 4-cycle or 2-cycle engines, and automobile engines were developed on both plans, though very unequally. Gottlieb Daimler and Karl Benz selected the 4-cycle type for the small and experimental vehicles built by them in 1884, 1885 and 1886, from which the first automobile constructors in France received their inspirations, and when France soon afterward took a decided lead in production and design the 2-cycle engine was neglected by the majority of engineers in the matter of developing it for vehicle work. It continued in favor for small motor boats in England and America, received the benefits of the rapid improvements in materials and production methods extending to all classes of hydrocarbon engines, and every now and then it has been taken up for use in automobiles. But in nearly every instance of this sort it was eventually abandoned again, falling behind the 4-cycle type, to whose improvement by far the larger resources were devoted. The common prototype of the class of engine primarily to be considered is thus the single-cylinder, 4-cycle engine described and illustrated under GASOLINE ENGINE, STATIONARY. By taking note of the deficiencies for vehicle work which cropped out from the moment it was applied for this new purpose and by following the efforts made for removing these shortcomings, one arrives at length to any and all of the types now in use, each type representing originally some variation in judgment with regard to the relative importance of different requirements or the means for meeting them. In the prototype of automobile engines the following shortcomings were immediately apparent: The great weight, due to thick castings, large flywheel, large water tank and water supply. Violent shaking and vibration, due to single-cylinder design and unbalanced mass of piston, connecting-rod and crankarms and crankpin of the engine shaft. Failure to operate at more than one speed, due to ignorance of suitable methods for varying the fuel feed and, in lesser degree to ignition, by hot tube or defective electric apparatus. Unreliability at any speed, due to poor castings, wrong composition and weak compression of the explosive charges, overheating, failing lubrication. Small and irregular power development, due to overheating, low maximum speed, small valve ports and gas conduits, poor composition of fuel mixture. Noise and odor of exhaust, due to single-cylinder design, incomplete combustion of explosive mixture and unsuitable mufflers. Noise of engine and cam gears, due to unbalanced mass of rotating and reciprocating parts, poor design and cut of the gears.

As the construction having these faults represented the best knowledge of its day, it could be improved only by degrees, in the measure as knowledge grew among designers and skill and production facilities were developed in the industries supplying new materials and machinery. When one fault was alleviated another one was often aggravated by the remedy. Saving weight by using a smaller flywheel, for example, made shaking and vibrations worse and starting of the engine more laborious and uncertain. Reduction of the water supply made overheating—with dwindling of power and seizure of pistons—for a long period a most common trouble, and while radiators were at once devised to take care of excess heat the improvements in carburetors and ignition, resulting in more power and higher speed kept the generation of surplus heat ahead of the radiator improvements and other improvements for checking it. In more recent days, larger valve ports and lengthened piston stroke doubled and trebled the engine speed and power that could be obtained from a cylinder of a given bore, but resulted also in the return of vibration and difficulties in effecting ignition and lubrication rapidly enough, and these reverting troubles had to be remedied in turn by further lightening and finer balancing of reciprocating parts as well as by subtle changes in valve and cam shapes and settings, so as to get combustion started and finished to best advantage, before a practical gain in engine values could be realized from the increased speed and power. To be able to operate this improved engine slowly and with small fuel charges as well as rapidly and with full charges is still an object to be realized in the same degree that was attained in the heavier, larger and slower engines which preceded them in the evolution.

These instances of correlation among

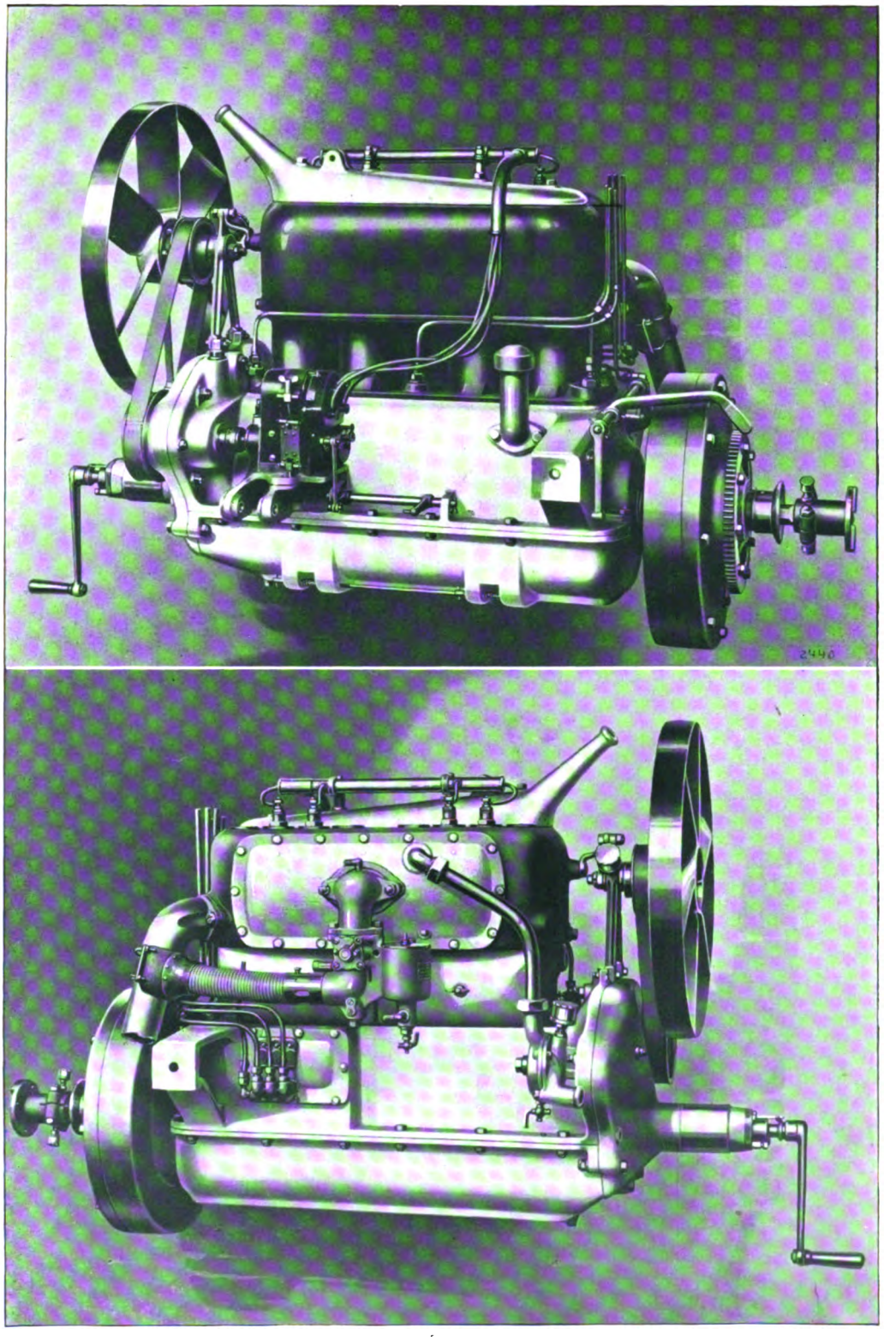


Fig. 4 — Typical 1917 4-cylinder Motor Car Engine, with Electric Starter and provision for heating the carburator. Left and right side views. Omitted: Radiator and its connection to waterpipe at top and to centrifugal pump below (to the right)

merits and defects — out of many that could be mentioned — are characteristic of the automobile engine as an organism in which success or failure comes from harmonious interaction among all mechanical features as much as from the design and peculiarities of any of them. Carburation, fuel induction, ignition, compression, combustion and expansion and even lubrication — all important and complicated functions — must in the highest type of engine often be performed several thousand times each minute and each time in a preconceived manner and in minutely regulated time and space relations of one to another, these relations varying moreover according to the engine speed.

Evolution of the automobile engine has for the reasons implied in these facts been a rapid succession of compromises among conflicting factors. Many advance steps have at first been too boldly conceived and had to be retraced to wait for related improvements not yet ripe, at the time, for mechanical realization.

The modern single-cylinder motorcycle engine (see MOTORCYCLE) cooled directly by the atmosphere represents the simplest engine unit in which every unsuitable feature of the stationary gasoline engine prototype has been changed in kind or degree to gain reliability and meet the requirements for vehicle work on essentially the same plan that has been followed for automobile engines, although the urgent need of lightness has here caused the adoption of cooling by air instead of by water and has reduced the number of cylinders, in most cases, to one or two.

For automobile engines, on the other hand, cooling by water was originally found so much easier to manage that its cost, weight and encumbrance were almost universally accepted as a lesser evil than the unreliability thought to be inseparable from cooling by air alone, and only one American manufacturer of motor cars now employs the latter system, using forced air draft for each cylinder. As a small cylinder is more easily cooled than a large one (having a larger surface to which the cooling medium can be applied in proportion to its volume and capacity for heat generation), and as 6, 8 and 12-cylinder motors with small cylinders are gaining in favor, while aluminum is also coming into use as an engine material for pistons and cylinders and is more readily cooled than iron, having much greater conductivity (see HEAT), the possibility of a much wider adoption of air cooling is not excluded, especially in conjunction with a moderation of engine speed; for example, for light vehicles for which the smallest practicable dimensions of a four or six cylinder engine give an abundance of power without pushing the engine speed to the attainable maximum.

Among the features in the original engine, of which no trace is left in the modern designs shown in the accompanying illustrations, the surface-evaporation carburetor, the automatic inlet valve, the hit-and-miss speed control acting by blocking the exhaust, and the hot-tube ignition were those which were mostly responsible for the immense difficulties in utilizing the engine with equal facility for different vehicle speeds, different loads and different road grades. To change the constant-speed engine into a source of variable power, with the amount of power and the rate of its delivery — the torque and angular speed of the crankshaft — under the required instantaneous control, it was first of all necessary to revolutionize the carburetor. As the engine is the heart of the motor car, so the carburetor is the soul of the engine. Theories on the necessity for complete evaporation delayed the advent of the float chamber and the jet. Years followed, during which the Krebs diaphragm or a sliding sleeve was employed to secure approximately the same composition of the explosive mixture at one engine speed as at another, the spray from the jet in conjunction with a butterfly valve in the induction pipe having already made it possible to vary the engine speed considerably. But moving parts wore at their bearings, so that adjustments did not stay true, and much finer control was wanted. The whole subsequent development of carburetor mechanics has been divided between the two objects of securing this fine control for all desired degrees of engine power and speed (high engine speed with low torque being as frequently wanted on hard and level roads as maximum torque at low speed to turn the crest of a hill without gear change) and of reconciling it with the constantly decreasing volatility of the fuel obtainable in the market. Increasing number of cylinders in the engines, all to be supplied from the same carburetor, and rapidly increasing maximum speed of the engines due to other advancement in the construction, made the task an unceasing one. Hereto came a demand for rapid acceleration or "pick-up," also to be complied with. The expedients adopted may be classified in groups mechanically, but are so variously modified and combined in the several hundreds of carburetors manufactured for the market that no single scientific principle has been demonstrated as governing the control of carburation when it is undertaken on the basis of a spray-jet from which a variable air current must siphon the fuel. As the volume of the liquid gasoline should be only about one eight-thousandth part of the volume of air with which it is mixed in atomized or vaporized form, the variable features in the control cannot successfully be applied directly to the flow of the liquid, such as by having the throttle reduce or enlarge the apertures of the jet, but must be applied to the air, its course and its velocity, and the air current, so varied on one plan or another which has been found suitable, must cause the discharge of liquid to be varied in proportion to the volume of air used. The greatest difficulty arises from the fact that an air current of doubled volume siphons much more than double the amount of fuel from an ordinary tubular jet, and compensation for the excessive siphoning action must be made. Also, when the air current is strong, with the throttle open, and the engine cylinders are filled up completely by the suction stroke, the compression of the charge becomes greater than if the cylinder is only partly filled, and to realize the best fuel economy, the highly compressed fuel mixture should be leaner than one less compressed. To compensate for this factor special devices are sometimes employed which admit air above the throttle to thin the gas mixture at the engine speeds giving the highest torque. The expedients which are normal features in the carburetors are exemplified

on the constructions shown in Figs. 1, 2, 3 and 4, and are briefly explained in the captions for each of them. In order to produce a noticeably rapid acceleration it has recently become a somewhat general practice to have a plunger connected with the throttle or accelerator lever

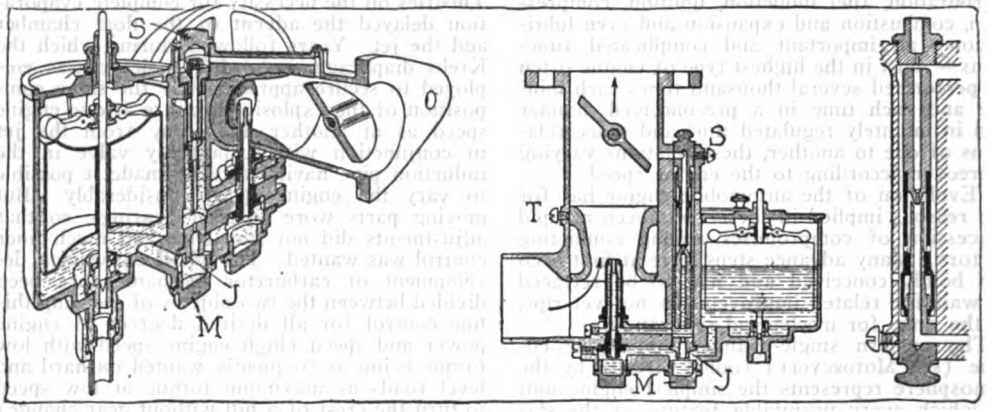


FIG. 1.— Sectional views of widely used carburetor of French design in two patterns; one with horizontal delivery pipe (to the left in illustration) and adapted to be mounted high on block-cast engine, avoiding exposure of pipe and condensation of fuel vapor; other with vertical delivery pipe, as used for engines providing heating by water or exhaust gas of the conduits. Larger scale view (to the right) of auxiliary jet for "idling" engine and fuel reserve for rapid acceleration. Main jet in choke-tube has central channel fed with fuel through duct J from float chamber, and annular channel fed through same duct that feeds auxiliary jet S. Latter connects with atmosphere at top and when engine is operated with throttle flop open fuel in auxiliary jet drops low and suction pulls air into annular channel of main jet, mixing with the fuel and keeping proportions in fuel mixture correct. When throttle is closed, suction from cylinder acts close to aperture of auxiliary jet and draws a relatively rich mixture, as required for "idling."

in such manner that for a moment after the throttle has been opened to cause acceleration an additional air current is sent from the plunger pot through or past the jet, to produce an action which is at once as strong as that which the same throttle opening otherwise gradually causes by increasing the engine speed.

with poppet valves are of the L-head, the T-head or the top-valve type. The questions involved in the designer's choice among these, aside from cost of construction and commercial expediency, have changed in the course of years. Sound cylinder castings were hard to obtain for many years, with intricate coring for water jackets, except in symmetrical shapes, and this factor gave the preference to the T-head type before the top-valve type was known. It is now seldom used, the art of casting having advanced, bringing the functional factors of the engine into relatively greater importance.

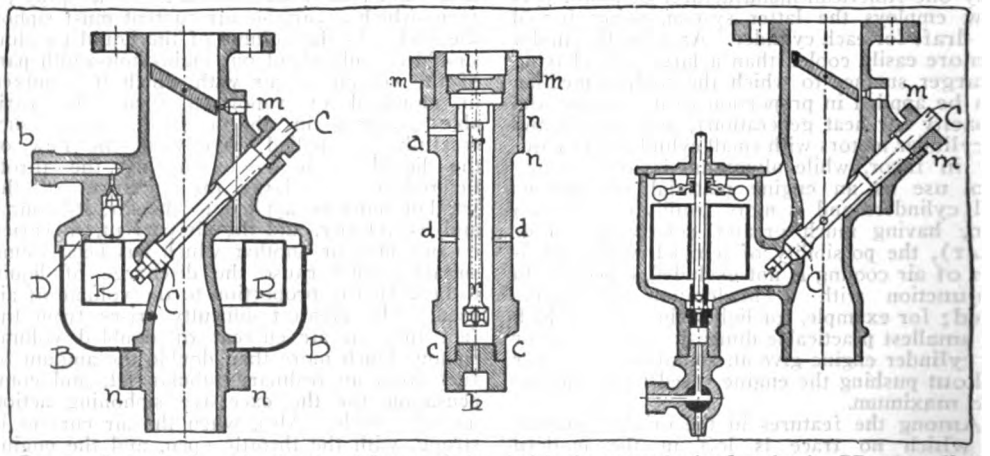


FIG. 2.— Sectional views of carburetor of German design. At left, the pattern having float chamber BB surrounding the choke-tube (venturi-tube); in middle, larger scale view of oblique jet (*cc*) dipping into fuel supply at lower end adapted for drawing air at upper end to mix in form of air bubbles with spray of fuel at *dd* when throttle is open (it is shown closed). At right, same carburetor with float chamber at the side, as preferable if used for heavy fuels requiring adjustment of the float to raise level of fuel and bring it nearer to spray apertures *dd*.

The arrangement of valves and valve-actuating mechanicism largely determines the dimensions of valves that can be used for a cylinder of a given bore, and thereby the maximum engine speed under load. According to what arrangement is adopted, automobile engines

These functional requirements are (1) compact combustion chamber with a minimum of wall area to get rapid ignition and inflammation from a centrally located spark plug and full benefit of gas expansion against the piston before cooling can take place in appreciable

degree; (2) large valves and direct passages for fuel charges and exhaust gases, these being the main factors in "volumetric efficiency" which is the ability of the engine to take in and discharge gas with a minimum of skin friction and vortex action; (3) minimum weight of valve mechanism, to reduce vibration and noise; (4) accessibility of valves and valve seats, to facilitate inspection and repair; (5) minimum formation and ready removal of carbon deposits, the latter being due mostly to residues from incomplete combustion of lubricating oil on the cylinder walls; and (6) reliable lubrication of the valve actuating mechanism.

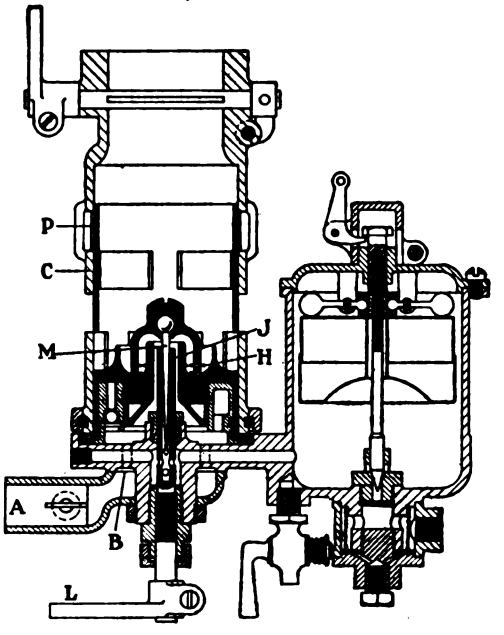


FIG. 3.— Modern American carburetor of design including unusual features. Auxiliary air supplied through ports uncovered at high engine speed by tubular piston P moving in cylinder C having upper and lower ports. "Metering pin" M attached to piston P by ball at its upper end but free to move upward as gasoline is drawn up around it from main jet J, the discharge aperture in which is regulated by the position of metering pin in it. Hot air hose A. Series of holes B admit main supply of air to cylinder C, the air passing through annular channel around spray-jet H. Lever L furnishes adjustment to conform with size and design of engine by raising or lowering jet H, thereby changing its relation to metering pin.

In the quest for a small engine with a high maximum power and a wide range of speed these factors are all of importance, and it is usually admitted that the top-valve type, with the camshaft located on top of the cylinders, admits of the highest power development, closely followed however by the L-type arranged with the intake valve in the wing and the exhaust valve in the top and operated by a rocker arm. In all cases the possibility exists of obtaining equal maximum power and greater "flexibility" in operation from a slightly larger and heavier engine with relatively smaller valves. The valve timing can be made nearly correct throughout the smaller range of engine speeds. Thus the L-type with both intake and exhaust valves in the wing (and each of them therefore rather small) is commonly employed. A modern instance of the T-type, with two camshafts, for a 6-cylinder engine of high class and cost is shown in Fig. 5, the valve tappet rods being encased by means of aluminum covers on both sides. Though little used now, this type can have large valves and high speed.

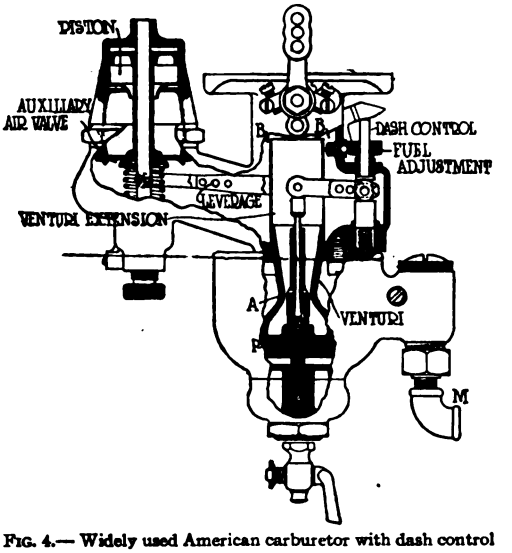
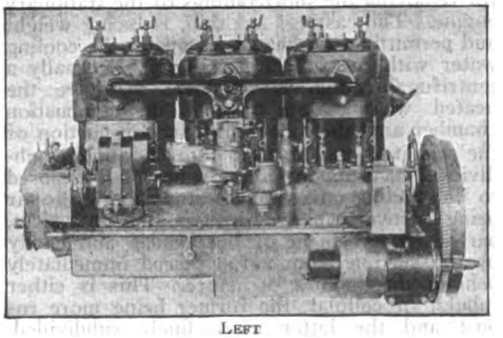
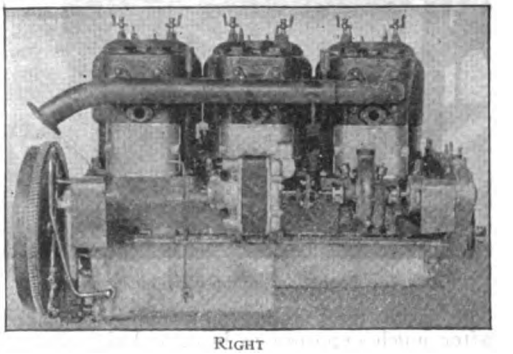


FIG. 4.— Widely used American carburetor with dash control

Fig. 6 shows a sectional view of a 4-cylinder L-type engine, all cylinders cast in one block, as now usually done. Fig. 7 shows a 4-cylinder top-valve engine with details of mechanism in Fig. 8. Fig. 9 an 8-cylinder engine. To make



LEFT



RIGHT

FIG. 5.— Left and right side views of 6-cylinder pair-cast, high class automobile engine of T-type.

the power impulses follow one another at equal intervals, one row of cylinders in this engine forms a right angle with the other. In 12-cylinder engines of the same type, which are also used, this angle is reduced to 60 degrees,

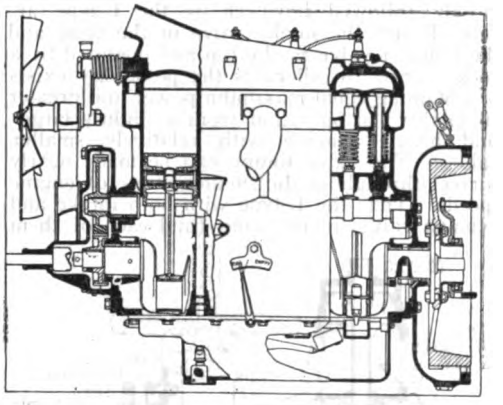


FIG. 6.— Four-cylinder, L-type engine, block-cast.

whereby the engine becomes narrower and more easily disposed of under the hood, the parts are more accessible, while the great advancement in the utilization of automatic machinery in the production of engine parts makes the difference in cost less than it could have been a few years ago. A tendency is thereby established toward the use of many small cylinders rather than fewer and larger ones. The crankshaft of a multicylinder engine fully balanced by counterweights at every point to obviate vibration in the last degree is, however, a complicated forging. The ability to produce such shafts by drop-forging from one piece of steel has been developed mainly in the United States, while on the other hand the art of producing complicated and yet sound cylinder castings was first developed in Germany, France and Belgium. In the beginning of the industry, cylinder heads were cast separately from the cylinders and were bolted on.

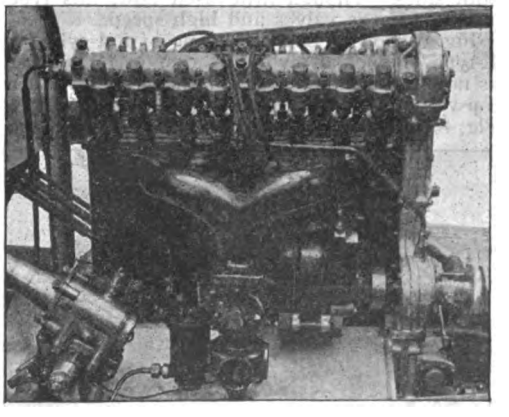


FIG. 7.— Four-cylinder, top-valve racing engine.

The gasket used at the joint frequently leaked after much exposure to heat, and the practice of casting all in one block was universally adopted. Lately, however, a return to separate casting of cylinder heads is noticed, this being due to considerations of cost, of new valve arrangements, better gasket materials and cheaper and more convenient repairs.

Fig. 10 shows an engine of the sleeve-valve type; in this case having two sleeves for operating the intake and the exhaust by the successive covering and uncovering of valve ports in the upper portions of the cylinder walls. First proposed in 1906 as an adjunct of an automobile exhibition in Chicago, this engine was subsequently perfected in England and France and is now widely used. The silence of its operation stimulated designers of poppet valve engines to the improvements by which the latter have also been made silent, mainly by better gears for camshaft, pump, magneto and fan and by the boxing of valve mechanism.

Another type of sleeve-valve engine, with a single sleeve, is also in successful use in England, where it is made. Many efforts have been made to produce automobile engines with rotary valves, usually arranged in the nature of a valve tube placed horizontally through the heads of the engine cylinders and arranged to open and close the ports in the cylinder heads by rotation and periodic registry with ports

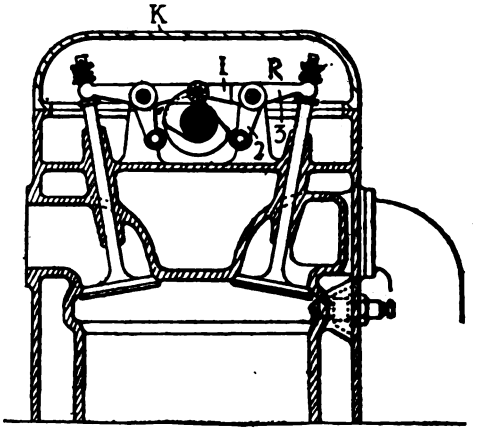


FIG. 8.— Details of a top-valve mechanism.

in the tube; but only one rotary valve engine is in practical use and has a vertical rotating sleeve at the top of each cylinder. It is of Italian manufacture.

By looking over Figs. 6 to 10 one notices in all of them a number of features adapted for removing the shortcomings of the stationary engine. The castings are thin, reducing weight and permitting the heat to escape to the cooling water with the required rapidity. Normally a centrifugal pump is employed to drive the heated water from around the combustion chamber and the valves into the top portion of the radiator and further into the finely subdivided ducts in the latter, where it is exposed to the cooling effect of the atmosphere, the air being drawn rapidly through the interstices, partly by movement of the vehicle and partly by the suction from a fan placed immediately behind the radiator structure. This is either tubular or cellular, the former being more robust and the latter more finely subdivided. Often no centrifugal circulation pump is used and the water is circulated by reason of its

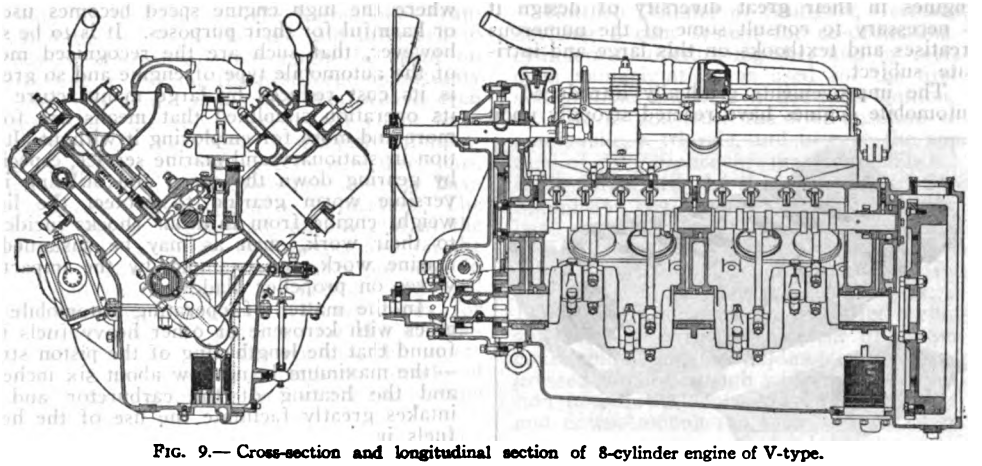


FIG. 9.— Cross-section and longitudinal section of 8-cylinder engine of V-type.

own variations of temperature, this "thermo-syphon" system to be effective requiring a considerable difference in height between the top of the engine and the top of the radiator, on the same principle that makes a high chimney create a stronger draft than a low one.

The ignition has kept pace with the increasing demands made upon it. So long as engine speeds were low, a primary or small storage battery produced a current whose voltage was raised by means of an induction coil with trembler. The magneto gradually took the place of this equipment, being adapted for producing a spark more promptly and always ready to work when mechanically actuated from the engine. Recently the employment of engine starters requiring the use of a storage battery has rendered it possible to dispense with the magneto for ignition, and improved induction coil devices are often used instead of it. See IGNITION; MAGNETO

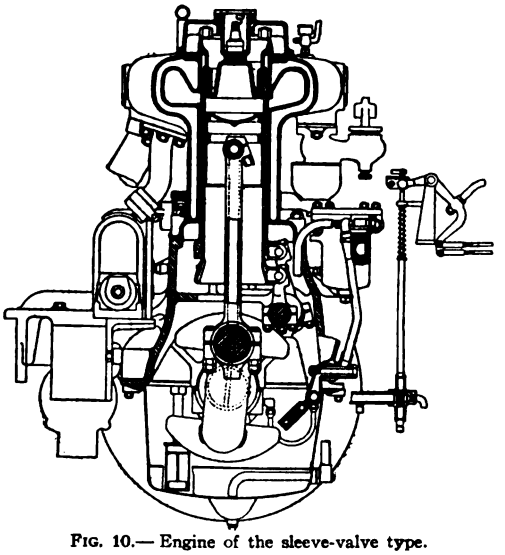


FIG. 10.— Engine of the sleeve-valve type.

Fig. 11 shows an example of the aluminum crankcase in which the shaft and the connecting-rod knuckles turn and whose lower portion, known as the sump, is usually removable and serves as a reservoir for lubricating oil. The usual system is to lubricate the pistons and cylinder walls by splash; that is, by the oil splashed from a shallow tray placed over the sump by the rapid rotation of the connecting rod ends, which are often provided with small scoops for this purpose. The bearings of the shaft are oiled from a gear pump operated in the lowest part of the sump, the oil being either forced through a continuous duct in the shaft and crankarms and pins or through a pipe above the shaft bearings, whence it is fed to the latter by gravitation.

Pistons and connecting-rods are made as light as possible, the latter either of alloy steel or of aluminum. A steel piston lightened by perforations in its skirt is shown in Fig. 12. Pistons and cylinders of aluminum are the exception but are not uncommon, although this metal expands and contracts about three times as much as iron or steel by changes of temperature. Aluminum cylinders are so far normally lined with thin steel.

Mufflers or silencers for reducing the noise of the exhaust gases formerly consumed an appreciable amount of power by hindering the escape of the gas — sometimes one to two horse-power — and by the back pressure and retarding of the flow contributed greatly to overheating of the engine. The improved constructions, while regulating, cooling and contracting the gases, create less resistance than would be encountered if the gas were released at its first temperature and sped directly against the atmosphere. Yet in most racing machines it is so released, perhaps with an eye to the spectacular effect.

The sum of the development of the automobile engine from its stationary prototype has been that of transforming an engine capable only of turning its crankshaft over with a certain power and at a certain speed into one whose power may be varied from 100 to 3 per cent of its maximum while its speed is varied from 100 to 10 per cent, all by the effortless shifting of air currents in a carburetor to change the rate of fuel and air feed and an accompanying regulation of the spark by which the fuel gas is ignited.

For further facts and details of automobile

engines in their great diversity of design it is necessary to consult some of the numerous treatises and textbooks on this large and intricate subject.

The improvements gradually introduced in automobile engines have reacted strongly upon

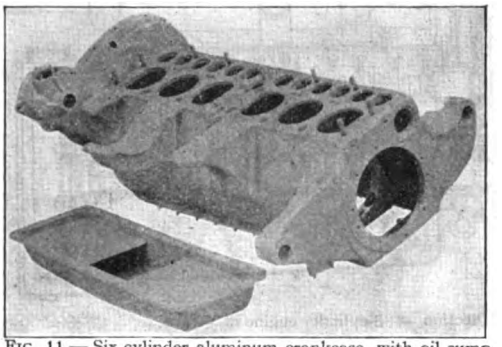


FIG. 11.— Six-cylinder aluminum crankcase, with oil sump shown separately.

stationary and marine engines, to the effect that engines of the automobile type are now frequently used for stationary and marine work. In the measure as manufacture of automobile engines on a large scale has reduced their cost, engines for motor boats are becoming very similar to those used for motor trucks in the sizes below 60 horse-powers, and engines for racing boats similar to those for racing cars. The larger boat motor engines are however influenced by Diesel engine design. (See DIESEL ENGINE). To maintain a distinction between the automobile engine and small stationary and marine engines of the most advanced type, it may be said that for the latter the weight of the en-

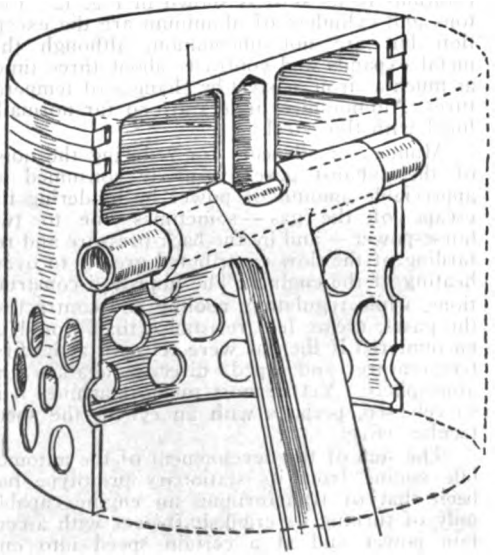


FIG. 12.— Light steel piston construction.

gine is relatively unimportant while robustness, low cost and suitability for operating with kerosene as fuel are important, and their makers therefore usually follow the continuous development of the automobile engine only to the point where weight reduction becomes costly and where the high engine speed becomes useless or harmful for their purposes. It is to be said, however, that such are the recognized merits of the automobile type of engine and so greatly is its cost reduced by large manufacture and its operation simplified that means are found more and more for employing it without alteration in stationary and marine service, especially by gearing down the speed and utilizing irreversible worm gearing to protect the lightweight engine from injurous shocks incidental to their work, such as may be sustained in marine work, for example, by the impact of waves on propeller blades.

In the matter of operating automobile engines with kerosene or other heavy fuels it is found that the lengthening of the piston stroke — the maximum being now about six inches — and the heating of the carburetor and air intakes greatly facilitate the use of the heavy fuels, including alcohol mixtures, after the cold engine has been started on gasoline, but it still remains doubtful if the heavier fuels can ever be used exclusively and under all circumstances of climate and temperature so long as the fuel mixture is introduced by means of the suction stroke of the piston causing an air current that merely siphons the fuel from a jet. Developments for making the automobile engine one adapted for many sorts of fuel still belong in the main to the future.

MARIUS C. KRARUP.

AUTOMOBILE INDUSTRY. Though small and of doubtful stability until about the year 1903, the automobile industry has not only grown to be the first in financial magnitude among all the industries in the United States which turn out finished products, and to a similar position in the leading European countries, but has exerted the strongest formative and stimulating influence in several other metal-working industries and arts which were laid under contribution for materials and parts and driven to efforts the results of which were found so widely applicable as to be at once exploited eagerly and broadly in many other directions, to the effect of greatly increasing and improving the world's productive facilities in all commodities adapted to be made by automatic machinery wholly or in part. These influences, and especially the widening of the use of jigs, working-jigs, gauges, machine tools and specialized machinery, have been incalculable. They have revolutionized all previous methods in factory organization and have established a new standard for industrial accuracy as well as for the physical testing of materials.

In securing accuracy in the new sense, uniformity in results and method in producing them take precedence over painstaking measurement; specific gauges take the place of adjustable instruments, and the need of subsequent fitting, previously the pride of skilled mechanics, becomes a fault.

In these respects the automobile industry has followed in the footprints of the bicycle industry, which however was not of sufficient magnitude or industrial scope to make the whole technical world take note and follow, besides representing an earlier stage of the development. It has fallen to the lot of the automobile industry to work wonders, because science and art and finance were ready to be lavish with all their untried resources when this new com-

modity of high price — the automobile — captivated the spirit of the age and promised to repay amply for all that might be spent on perfecting it, offering the first large opportunity of this order, and one which has proved even larger than the most far-sighted could have anticipated 20 years ago. Constantly stimulating initiative and enterprise in new directions, the successes of the automobile industry have inaugurated a new epoch in civilization: The Age of Motors. On land, on sea and in the atmosphere, in mines, in fisheries and on the farm, in sports and in utilitarian pursuits, in the rapid transportation of persons and mail as in the slower transport of heavy goods, for the requirements of peace as for the destructive activities of war, the engines, the super-steels and the production methods introduced through the automobile industry have become indispensable.

The historical background of the automobile industry is, rightly seen, nothing less comprehensive than the entire scientific, technical, industrial and commercial development following in the wake of the steam engine, Bessemer steel, coal oil, electro-magnetism, metallurgical and organic chemistry, but it is customary to point to early efforts for producing road vehicles driven by steam engines as the historical element of the automobile industry. A currently accepted list includes the following as the more important among these efforts:

N. J. Cugnot's steam tractor, built 1769, intended for hauling artillery.

Richard Trevithick of England developed steam engine; built steam coaches 1801–03.

Oliver Evans of Philadelphia improved steam engines 1784, built vehicle 1804.

William Henry James, water tube boiler in 1823, vehicle seating 20 in 1824, another in 1829.

Pecqueur, 1828, built vehicle with rotary steam engine, chain drive, differential gear and Ackerman steering system (same as now used).

Goldsworth Gurney, 1825–30, Walter Hancock, 1830–36, F. Hills, and others in England built many steam vehicles, mostly coaches, which ran for thousands of miles without decisive failures but were hard on roads. In response to public opinion Parliament stopped the development by taxation.

In the United States steam road vehicles were built in 1825 by Thomas Blanchard at Springfield, Mass.; by J. K. Fisher of New York in 1840 and 1853; by Richard Dudgeon of New York in 1857 and 1859.

S. H. Roper of Roxbury, Mass., about 1870 developed steam vehicles, tricycles, with fireflue boilers, which were used successfully and were improved by his sons and others. And the steam plant in these vehicles, much lighter than any previously produced and much more easily started, with gasoline as fuel, formed the technical foundation for the steam carriages and runabouts of which several thousands were made from 1898 to 1903 and used both here and in Europe. With regard to this manufacture and its continuation at the present day, see STEAM VEHICLE.

The actual beginning of the gasoline engine automobile is traced to the formulation of the 4-cycle gasoline engine principle by Beau de Rochas and the Belgian inventor, Jean Joseph Etienne Lenoir and to the exhibition of an engine of this type by Lenoir in Paris in 1878.

Gottlieb Daimler of Stuttgart, Germany, by devising a cam system for co-ordinating two cylinders to operate together and by replacing open flame ignition, as used for the first gas and gasoline engines, by hot tube ignition, was enabled to construct the first gasoline engine automobile, a tricycle, and to earn the appellation of "the father of the automobile." The claim for priority he shares with Karl Benz of Mannheim, Germany. Both produced primitive but operative gasoline automobiles in 1884, 1885 and 1886. Maybach (after Daimler's death in 1900 the leading engineer of the German Daimler company) several years later, about 1897 or 1898, devised the spray-jet carburetor and thereafter the development of automobile construction and the automobile industry progressed rapidly, though with periods of stagnation in improvements and with numerous ups and downs among the rank and file of manufacturers.

With regard to the share of electric automobiles in the history and the subsequent development, see ELECTRIC VEHICLE. The great part played by the closely related rubber tire industry which rivals the parent industry in value of annual output is referred to under RUBBER and RUBBER TIRES.

In a general way the automobile industry is divided into four branches: Manufacture of complete vehicles, manufacture of component parts, manufacture of accessories and manufacture of carriage work and vehicle bodies. The last-mentioned branch has been taken over to a considerable extent by the concerns which built vehicles or carriages before the advent of the automobile. The division lines are vague. Many firms whose main product is motor cars make also motor wagons and motor trucks. A considerable number make only commercial motor vehicles and constitute what is often looked upon as a separate motor truck industry and have associations and trade journals apart from the rest. But the Society of Automobile Engineers, which is widely recognized as having the common technical interests of the industry in charge, draws its membership from all branches and is extending its activities to matters related to the technics and production of motor boats, aeroplanes, tractors and self-propelled farm machines. Its most important work has consisted in the establishment of standards in construction elements, being the selection of a limited variety of dimensions and shapes in raw materials as indispensable to meet the needs of the designers in the automobile industry and, coupled herewith, uniting the producers of the materials in an understanding with the designers to the effect that minimum delay and lowest cost are secured on both sides by avoiding departures from the selections made, these being subject to revision, however, from year to year. The value of this "standardization" work for expediting and cheapening production, without interfering greatly with the freedom in new design or the advancement of merits in construction, has been recognized also outside of the United States.

Several large concerns manufacture within their own establishments and from raw materials the frames, axles, gears, clutches, shafts, springs, wheels, carriage bodies, as well as engines and carburetors which enter into their

completed vehicles, but a much larger number furnish the desired designs to manufacturers of component parts, especially the frames, axles, springs and wheels, and have them made to their order, sometimes under supervision by their inspectors. Many other automobile manufacturers adopt their design to a comprehensive selection of the components which the manufacturers of the latter have designed and produced for the market in general and with a view to the needs which, in their opinion, the builders of automobiles have in common. About 50 firms make a specialty of producing engines for the industry. Large manufacturers of complete automobiles have been started on the plan of obtaining all but a few characteristic parts and features from the auxiliary branches of the industry and, in the measure as commercial success was attained, have enlarged the scope of their individual design and production, finally controlling them in all the essentials.

The manufacturers of components, on the other hand, were usually engaged in forms of metal or steel manufacture having nothing to do with automobiles before they entered this field and, while many of them still continue such unrelated manufacture in other lines, the largest and most successful ones among them have as a rule confined themselves more and more to automobile products and turn these out in ever-increasing quantity. An exception in this respect is the manufacture of electric generators, motors and storage batteries, which remains almost a separate industry with its most important interests in other directions.

From the beginning the American automobile industry adopted the plan of making and selling complete vehicles to the public, while European manufacturers produced only a chassis and left it to the customer to have a carriage body fitted to it by a carriage builder of the customer's own choosing. The American plan was later extended to embrace also the equipment with accessories, such as lamps, odometers, cyclometers, horns or other signal devices, windshield, shock absorbers, storage battery. Finally, an engine-starter equipment is now frequently also included in the outfit to which the selling price applies, and in some instances an engine-driven air-compressor to facilitate the inflation of tires. The European industry follows slowly in adopting these practices. Most of the smaller accessories continue to be made by specialty manufacturers who sell in large lots to the car makers and in smaller lots to the retail trade.

Motor wagons and motor trucks did not begin to be made on a large scale until automobile

PRESENT MAGNITUDE OF THE AUTOMOBILE INDUSTRY

Compiled by Alfred Reeves, General Manager of the National Automobile Chamber of Commerce

Motor Car Manufacturers

Motor vehicle manufacturers in United States	550
Commercial vehicle manufacturers	372
Passenger vehicle manufacturers	238
States in which factories are located	32
Capital invested	$736,000,000
Workers employed	280,000
Wages and salaries paid during fiscal year ended 30 June 1917	$275,000,000
Motor vehicles produced in last fiscal year	1,806,194
Passenger cars produced	1,693,994
Commercial cars produced	112,200
Wholesale value of vehicles produced during last fiscal year	$917,470,938
Paid for parts and materials by automobile manufacturers during last fiscal year	$480,000,000
Production passenger cars in calendar year 1917	1,795,840
Production commercial cars in calendar year 1917	181,348
Average price of passenger cars produced in 1917	$720

Body, Parts and Accessory Makers

Number of concerns manufacturing some article used in in auto trade	6,789
Body, parts and accessory makers in United States	1,080
Capital invested by body, parts and accessory makers	$336,000,000
Workers employed by body, parts and accessory makers, 320,000; workers' wages paid yearly at $900 per man	$288,000,000
Automobile tires manufactured during fiscal year ended 30 June 1917	18,000,000
Value of tires manufactured in last fiscal year	$450,000,000

Dealers, Garages, Etc.

Total dealers, garages, repair shops, etc., in United States	46,000
Automobile and truck dealers in United States	27,000
Garages	25,500
Automobile repair shops	13,500
Tire vulcanizers	12,000
Automobile supply houses	2,550
Jobbers of automobile supplies	282
Capital invested by dealers, garages, etc., estimated at $4,000 each	$184,000,000
Workers employed, estimated average of five each	230,000
Wages paid, estimated at $800 per man	$184,000,000

Automobile Exports

Value of automobiles, trucks, engines, tires and parts exported year ended 30 June 1917	$133,411,217
Number of passenger automobiles exported last fiscal year	64,834
Value of passenger cars exported	$48,620,928
Number of commercial cars exported last fiscal year	15,977
Value of commercial cars exported	$42,337,315
Value of automobile engines, tires, and parts exported last fiscal year	$42,452,974

Motor Vehicles in Use

Motor vehicles registered in United States	4,842,139
Motor vehicles in New York State	418,000
Motor trucks in use in United States	435,000
Tons of goods hauled yearly by trucks (estimated)	1,200,000,000
Cost of haulage by motor trucks at 18c per ton-mile	$1,080,000,000
Cost of haulage on basis of 24c per ton-mile by horse and wagon	$1,440,000,000
Value of passenger service at railroad rate of 2c per mile	$1,152,600,000
Number of persons in United States to one motor car	24
Number of persons to one motor car in 11 Middle West States	17
Number of persons to one motor car in 11 Eastern States	26
Percentage of cars sold to farmers in 1917 (estimated)	40
Number of automobiles in United States to each mile of public road	1.72
Number of automobiles in United States to each mile of surfaced road	14.77
Number of automobiles in United States for each square mile	1.4
Automobiles in use in all countries outside of the United States 1 Jan. 1917	719,246
Automobiles in use in Europe 1 Jan. 1917	437,558
Automobiles in use in Canada 1 Jan. 1917	118,086
Automobiles in use in South America 1 Jan. 1917	39,188
Automobiles in use in Australasia and Oceanica 1 Jan., 1917	55,340
Horses in the United States	24,000,000
Acres of land required to sustain horses	120,000,000
Horses displaced by motor trucks in use (estimated)	2,000,000

construction was far enough advanced to make the business world feel assured that they were suited for performing commercial transportation work more economically, in most lines of business, than it could be done by the old system. But since about 1908 the number of trucks and delivery wagons has increased very rapidly, while the number of manufacturers solely producing commercial motor vehicles has fluctuated notably from year to year, the difficulties in the design and production of durable vehicles of this class having been underrated.

The accompanying statistical tables and data give an idea of the magnitude which the industry has reached in the United States, but the war in Europe prevents the presentation of comparable data from the French, British, German, Austrian and Italian industries.

AMERICAN PRODUCTION OF AUTOMOBILES FOR THE FISCAL YEAR ENDING 30 JUNE 1916

[Compiled by the National Automobile Chamber of Commerce]

	Number	Retail price
Passenger vehicles	1,227,533	$912,060,829
Commercial vehicles	75,867	157,060,790
	1,303,400	1,069,121,619

Out of this number of passenger vehicles more than 500,000 small cars representing a retail price of about $218,000,000 were made by one manufacturing company employing 31,000 men. This leaves the rest of the production of passenger vehicles at 727,533 and their selling price at $794,060,829. The average price of American automobiles, excepting one make, was thus slightly more than $1,000 between 30 June 1915 and 30 June 1916.

Data on the increase of production of five-year periods, some figures on electric vehicles and on exports, showing especially the influence of the European War on exports of commercial motor vehicles (to be used as war trucks) are compiled mainly from United States census reports as follows:

MOTOR VEHICLE PRODUCTION REPORTED BY UNITED STATES BUREAU OF CENSUS

Year	1904	1909	1914
Total number of cars produced	21,692	126,593	573,114
Electric carriages	1,425	3,826	4,715
Electric comm. vehicles	214	493	.....

The N. A. C. C. reports additionally that in 1912 there were produced 1,351 and in 1913 no less than 2,736 electric commercial vehicles.

The value of the exports in 1913 and 1914 was about one-twenty-eighth of the value of the domestic trade and in 1915–16 had risen to one-tenth of the domestic trade, although the latter had more than doubled in the same period. The distribution among the principal countries is shown in the following table:

UNITED STATES EXPORTS OF MOTOR VEHICLES TO PRINCIPAL COUNTRIES AT WAR FOR THE FISCAL YEARS 1916 AND 1917, ENDING 30 JUNE EACH YEAR

Year	1916		1917	
	No.	Value	No.	Value
France	7,768	$19,137,904	5,631	$14,691,460
Great Britain (in Europe)	18,428	26,147,882	7,797	18,508,442
Germany	none	none	none	none
Russia (in Europe)	5,177	15,686,874	2,513	6,371,982
Other Europe	2,673	3,402,422	5,094	5,227,081
Asia (mainly Vladivostok), in 1916	5,496	7,170,518	11,083	10,436,460

AUTOMOBILE INSURANCE. A contract of indemnity (1) against loss or expense by reason of the liability imposed by law upon owners or users of automobiles, for bodily injuries, including death, suffered by any person as the result of the ownership, maintenance or use of such automobiles; (2) against loss or damage by fire, theft or robbery, or transportation of automobiles; (3) against loss or expense by reason of the liability of owners of automobiles for damage to or destruction of property of others, except while in charge of the assured; (4) against loss by reason of the damage to or destruction of automobiles of the assured caused solely by collision with another object, either moving or stationery, except loss or damage by fire; or by striking any portion of the roadbed; or by striking steam or street railroad rails or ties.

Automobile insurance is divided into two principal classes: First, insurance of cars of the private and pleasure type; and second, of public vehicles, taxicabs and livery vehicles in general; commercial vehicles for transportation or delivery of goods or merchandise; cars used for demonstrating, testing and similar purposes by manufacturers, sales agencies, garages and service stations.

The premium charge for liability insurance in the case of private and pleasure cars is based upon the insurable horse-power, which is determined by a standard recognized formula of rating; the premium charge for public and livery vehicles is based upon the carrying capacity of the vehicle or is a fixed sum per car; the premium charge for commercial cars is based on the nature of the assured's business; the premium charge for cars used for demonstrating and testing and by garages, sales agencies and service stations is based upon the pay roll of all employees, including executive officers and office force, or on the number of chauffeurs named in the policy, or upon the number of cars specifically insured by manufacturer's number. In every case, the amount of premium is dependent upon the locality where the cars are principally maintained and used. The premium charged in the case of fire, theft and transportation insurance of automobiles is based upon the original list price as well as the year of model of the car, and the rate of premium increases with the age of the car and decreases as the list price becomes higher. A small increase in rate is also made for cars bought second hand in place of new. The amount of insurance granted is likewise dependent upon the list price and year of model and varies from 100 per cent of the actual cost of the car plus the equipment, in the case of new cars, to less than 25 per cent of the cost of cars more than five years old.

Automobile liability insurance has been writ-

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ten for only 10 years in this country, but in that comparatively short period, the business has grown rapidly and has reached substantial proportions. A few companies only ventured into this field of underwriting at first, and for two or three years the business was confined to the larger organizations, but as the demand developed, and the field for this form of protection broadened, other companies essayed the business, until at the close of the year 1916, 43 companies were insuring under a single policy against liability for loss of life or personal injury; against liability for property damage; and against loss or damage resulting from collision. The premiums received and losses paid are unfortunately not available, for the reason that automobile liability is included under the general heading of liability insurance, in the statements and reports of casualty companies, and no separation is made by any of the companies of the figures pertaining to the automobile business alone, excepting in the single case of property damage premiums and losses that are reported together with an allied branch of insurance, known as Teams Property Damage. Some idea, however, of the volume of business transacted annually by these companies may be gained when it is known that during the year 1916, the premiums received for automobile and teams property damage amounted to $9,558,590 and losses paid to $3,853,763. As these figures represent only a relatively small percentage of automobile liability premiums and losses, it is easily conceivable that the volume of such business will in a few years exceed most other forms of liability insurance.

Automobile fire insurance covers the hazards of (1) fire, from external causes, self-ignition, explosion or lightning; (2) transportation; (3) theft; (4) property damage (5) collision damage. Ninety-five companies transacted this kind of insurance during 1916, whereas several years ago such insurance was entirely unknown in this country. An innovation was introduced within the last few years by the issue of a "joint" policy, consisting on one side of a contract of fire insurance, by some well-known company, and of liability insurance, by some equally prominent company, on the other side. The main advantage claimed for this dual contract was that complete coverage was thereby afforded in one policy, but the plan did not meet with unqualified success, and the greater part of the business is now written in separate policies. The fire insurance policy usually includes fire and theft and collision damage and the liability policy covers personal injuries and property damage. In 1918 the National Automobile Underwriters' Association recommended that fire and theft motor insurance be included in one policy, with a distinction in rates, and providing that only half the insured value shall be recovered in case of theft, but not affecting the fire insurance for which full value is assured.

The rapid growth of automobile fire insurance and the great possibilities for its future development are best indicated by the results achieved by the companies in 1916, which show net premiums received $17,320,342; net losses incurred $7,829,369. These figures, taken together with the automobile business transacted by the casualty companies during the year, indicate a total volume of premiums received exceeding $50,000,000, and of losses incurred of over $22,000,000.

EDWIN W. DE LEON.

AUTOMOBILE TORPEDO. The self-propelling torpedo, invented and constructed by Whitehead in 1870, did not show its potential power until 1877, in the war between Chile and Peru. Despite numerous and important improvements, it was considered even up to the opening of the Russo-Japanese War a weapon of uncertain value. Since that date, however, the opinion of experts has been changed. The first experiments show that the essential quality to develop was speed, and the efforts were largely along that line for a time. Then on account of the continually greater resistance of the armor of ships it was necessary to increase the explosive charge. Then the development of rapid-fire guns made it more difficult for the torpedo boats to approach their adversaries and greater radius of action was necessary in the torpedoes themselves. The different demands led to gradual increase in the calibre of the projectile, but here the question of weight came as a determining factor. It is necessary not to exceed the weight or, dimensions that can easily be handled. Next there was the use of compressed air for motive power. It has been through the combination of all these factors by dint of an enormous amount of ingenious invention and adaptation that the modern torpedo has been possible. See TORPEDO and WHITEHEAD TORPEDO.

AUTOMOBILES IN WAR. Previous to the breaking out of the European War in 1914 the potential value of the automobile in military operations had been recognized by army men, and its use had been tested in manœuvres, sometimes to the complete exclusion of horse-drawn equipment. In England a certain type of military automobile had been decided upon by the authorities, and in order to have a large number at hand in case of hostilities, the approved design received a subsidy. This type of vehicle, however, did not find favor with the British commercial public, and few of them entered into general use. In France, a similar forward-looking provision had been made for a supply of automobiles which could be commandeered for military purposes in time of need, but no special design was insisted on. Any automobile which would meet certain requirements as to performance received the subsidy. When the war broke out England found that there was no appreciable stock of the military automobile to be taken for service, and all kinds of motor vehicles were commandeered, and did measurably good work. The French had a very considerable number of approved machines at their disposal. But within a very few weeks after the war had actually started both the English and French governments were buying largely the regular stock American commercial automobile trucks. And these, with some minor modifications, have withstood successfully the vicissitudes of the most rigorous use. Of course, special service demanded special vehicles, and these had to be specially constructed.

The Germans on the other hand were well prepared with an almost innumerable fleet of standardized motor vehicles of every descrip-

tion. Many months before war was actually declared German automobile owners were notified by the authorities to send their machines to designated shops, where holes were bored in frames, and lugs bolted on. When the mobilization occurred every type of machine had its special attachments ready to be put instantly into place. The invading troops were rushed into Belgium and France in squadrons of motor vehicles at a speed three times faster than any recorded in military annals. Perhaps the most sensational feat of the war has been the transport of the 60,000 troops from Paris overnight to the flank of von Kluck's advancing army on the Marne. It was accomplished by thousands of motor cars of all descriptions from the city buses to the motorcycle which could carry only one. Another emergency use of unspecialized automobiles in war was the endless chain of 4,000 cars of all sorts which connected the battlefield of Verdun with the railroad station at Bar-le-Duc, 30 miles away, for a space of three months while a railroad was being built. This heterogeneous procession of cars 60 feet apart, and moving at the constant rate of three feet per second, carried in the needed supplies of every sort and brought out the wounded.

During the punitive expedition of the United States troops into Mexico whole regiments with their supplies and equipment were moved at a speed of 125 miles per day, four times faster than would have been possible with horses.

On 1 July 1916 it was estimated that on the western battle front the British and French troops had in action about 60,000 automobile vehicles, of which number nearly 25,000 were of American manufacture. Experience with so many machines of so many different types soon led to a decision as to the chief requirements of the war automobile. The machine which has proved most effective has been the 3½-ton truck of French make, and the 3-ton truck of American make. The weight of these machines is about 6,000 pounds. They are of the platform type, the floor 138 inches by 67 inches, with removable sides 24 inches high. The engine most in favor is of 4 cylinders, averaging about 3.9-inch bore and 5.7-inch stroke, housed under a hood. Gasoline is considered the only dependable fuel. Every variety of drive has been represented, but no superiority has been shown by any particular design. The large-diameter vertical-tube radiator was most successful, the honeycomb type being pronounced a failure. The pump circulation system was definitely proved superior to other systems. Mechanical self-starters were not demanded. The splash system of lubrication won out over the forced circulation method, chiefly because the pump in the latter system was free to pick up and send on to the bearings any kind of harmful dirt which might happen to get into the oil chamber. Ignition by high-tension magneto fulfilled all requirements. Four-speed gears were found necessary to meet working conditions, and the French constant-mesh gears were the only ones quite satisfactory. Where the truck was obliged to travel off the roads and over rough ground, chain-driven wheels were employed; in extreme cases caterpillar track bands were attached. One of the most radical alterations was the spoked wheel made of steel in place of the artillery type of wooden wheel. For lighter cars the steel disc wheel with solid rubber tires was found dependable. The tires adopted after much experience were 36 inches by 6 inches for the front wheels, and dual rear wheels with tires 40 inches by 5 inches. The driver's seat was fitted with a separate closed hood, generally of canvas, but sometimes of wood. The bodies were fitted with heavy hoops and canvas tops, the front and rear hoops being strong enough to carry a load of 650 pounds each, and the middle hoop a double burden. The object thus attained was the conveyance of wounded soldiers on slung stretchers on the return trips from the battle front.

For the hauling of field pieces the truck with 4-wheel drive was employed. This was heavily built, with a capacity of 12 tons generally with two trailers carrying ammunition and supplies. A few of these had 6-cylinder engines, but the 4-cylinder type predominated, and was favored. The engines were generally of 4¼-inch bore and 6-inch stroke. These heavy trucks are capable of transporting a 75-millimetre gun, and in the French service the trucks were fitted with jacks to take the weight off the wheels when the gun was fired. For hauling the heavy artillery, the 14-inch and 16-inch guns, the motor used was of the simple traction type with road wheels of large diameter driven by internal gearing. The caterpillar tractor of the agriculturist operated at a slow speed was found more expeditious and certain in the long run than any other machine. These heavy tractors hauled loads up to 30 tons distributed over two or three trailers, one or more of which might be dropped on grades or where the going was very heavy. One of the recorded accomplishments of an American-built tractor of this type was the transportation of a 20-ton gun 29 feet long a distance of 11 miles in 1½ hours. The muzzle end of the gun was supported by a trailer. For armored cars carrying machine guns representatives of nearly every type of motor vehicle have been employed, from the motorcycle with a sidecar to the big 12-ton truck carrying four machine guns and a field piece. The more common adaptation was based on a powerful 4-cylinder touring car upon which was built up a single compartment of steel plates about one-third of an inch thick, sometimes with a turret, and generally equipped with a wire-cutting device. The plating covered the engine and radiator, and the wheels were of the steel disc type, with solid rubber tires. These cars were supplied with flanged metal rims which could be quickly adjusted for travel at high speed on railroad tracks. Trailers were used behind nearly all cars, a favorite type being the two-wheeled float with canvas top. These were often fitted with seats to carry a large number of men, and operated up to a speed of 35 miles per hour. The so-called "tanks" of the British army are agricultural tractors of caterpillar model encased in half-inch steel armor. They weighed 15 tons and had engines of 120 horse-power.

Owing to the wide variation in construction of the many makes of motor vehicles in use on the Franco-British battle front, it was a hopeless task to attempt to supply parts to repair a damaged car, and in case of a breakdown the

car was simply abandoned for a new one. The loss was estimated at between 60 and 70 per cent of the car fleet, owing in part to the loading far beyond the burden which the cars were planned to carry. On the German front the cars were largely standardized, and rescue cars loaded with parts cruised about gathering up and repairing even the abandoned cars of the enemy. Some of these rescue cars were fitted up as machine shops, with trailers carrying supplies and parts. Others were derrick cars which lifted the broken-down car to the deck of a trailer and took it to a repair shop in the rear.

Specialized automobile machines appeared in large numbers as the war grew older. Among these were motor plows of 200 horse-power which dug trenches three feet deep faster than could be done by 100 men; roller tractors which not only smoothed newly made roads, but drew a train of loaded trailers behind; observation cars fitted with extension ladders to be run up high into the air; field laundries; sterilizing chambers for clothing; X-ray laboratories; perambulating bath-houses; and even traveling theatres for the diversion of the wounded. One of the more interesting emergency uses of commercial cars was the conversion of the London buses into refrigerator transfer cars for fresh beef. Another was the fitting up of a motorcycle with a side car with a complete wireless outfit.

In the United States regular army service there are battle cars fitted with rapid-fire guns; tank cars for gasoline, oil and water; anti-aircraft cars with guns mounted; 4-ton trucks carrying a 3-inch field gun with caisson — not mounted on the truck, however, as with the French 75's; a machine shop for repairs in the field; and a coffee percolator mounted as a two-wheeled trailer. These are, of course, in addition to the customary ambulances, field kitchens, etc., in general use in all military establishments.

Actual experience in the European War has proved that with the aid of the automobile in all its forms a whole army with its supplies and field equipment can be advanced at the rate of 30 miles per day, and a retreat can be conducted at the rate of 50 miles per day.

AUTOMORPHISM. This word is used by Spencer for the use we make of ourselves and our conduct as norms in the judgment of others. There is much in the experience of others that is not directly available to us. John Smith can give me a clear idea of the internal structure of his experience — he can tell me when two things appear of the same or of different colors, when he judges one thing better than another, or he can give me an analysis of his emotional life, but whether red really is to him the same color that it is to me, how he feels when he gives his moral assent, or whether his anger and my anger are qualitatively identical — all these things and many more are a sealed book to me. The only way in which I can fill in the outline which I obtain by conversation and observation is from the stuff of my own mental life. All knowledge of the mind of another, then, in so far as it is a knowledge of its intrinsic quality rather than of its structure, involves the use of automorphism.

AUTONOMY, the self-government of a state. This power may reside within limited bodies of the same people, such as parishes, corporations, religious sects. These districts or communities may be autonomous, if not absolutely, yet within certain defined limits. They may be said to enjoy a partial, limited or local autonomy. Autonomy is often used to designate the characteristic of the political condition of ancient Greece, where every city or town community claimed the right of independent sovereign action. Recently the word is more specifically used of territories or provinces, which, while subject in some matter to a higher sovereignty, are autonomous in other respects. The self-government enjoyed by the British colonies may be described as a modified form of autonomy.

AUTOPLATE, a machine for making and finishing curved stereotype printing plates for use in printing newspapers, invented by H. A. Wise Wood of New York, and first put into use upon the New York *Herald.* This machine, after a flexible papier-maché matrix, made from a type page, is inserted therein, proceeds to cast printing plates weighing about 50 pounds each, at the rate of four a minute, and to dress their edges and inner surfaces and prepare them for attachment to the printing cylinders, and this is done automatically — all within the compass of one machine. Previous to the advent of the autoplate such work had invariably been done by hand-worked devices, with which the fastest rate of production attainable was at the rate of slightly less than one plate per minute. So great a change did this invention make in the work of stereotyping upon the larger newspapers that not only was the machine generally adopted, but in every case the hand apparatus were entirely dispensed with, and sole dependence placed upon the autoplate.

AUTOPSY, meaning strictly to observe directly with the eyes, but more commonly applied to the close examination of a dead body to determine the cause of death. The autopsy is usually performed by the coroner in cases where death from poisoning is suspected, in which the contents and condition of the stomach are examined and subject to chemical analysis.

AUTOSSEE, Battle of, in the War of 1812. While Jackson was fighting the battles of Tallahatchee and Talladega in Alabama, the Georgians sent a force of 940 militia and 300 friendly Creeks under Brig.-Gen. John Floyd into the heart of the Creek country. On 29 Nov. 1813 Floyd drew up his troops in battle order in front of the Indian encampment at Autossee on the Tallapoosa near Tuckaubatchee and though the Indians occupied a strong position, a well-directed artillery fire and a desperate bayonet charge soon drove them out with a loss of about 200 killed, while Floyd lost only 11 killed and 54 wounded. Floyd then retired to Fort Mitchell on the Chattahoochee where he remained until the battle of Tuckaubatchee (q.v.). Consult Adams, 'United States' (Vol. VII, pp. 241–43); Brackenridge, H. M., 'History of the Late War' (p. 191); Fay, H. A., 'Official Accounts' (pp. 161–65); Pickett, 'History of Alabama' (Vol. II, p. 300); Miller, 'Bench and Bar of Georgia' (Vol. I, App.).

AUTRAN, ō-trän', **Joseph,** French poet: b. Marseilles, June 1813; d. there, 6 March 1877.

His verse is admired for its purity of form and refined sentiment. He attracted attention in 1832 with an ode to Lamartine, 'The Departure for the East.' His works include 'The Sea,' poems (1835); 'Milianah,' an epic (1842); 'Rural Life' (1856); and 'The Daughter of Æschylus,' drama (1848), which won a prize from the French Academy. In 1868 he was elected member of the Academy. His works were collected and published (8 vols., Paris 1881).

AUTREFOIS CONVICT, ō'tr-fwä' kôn-ve, in criminal pleading, a plea made by a defendant indicted for a crime or misdemeanor, that he has formerly been tried and convicted of the same. This plea is similar in form as the plea of *autrefois acquit,* and is based upon the same general principle, to wit: that no man's life or liberty shall be twice put in jeopardy for the same offense. A plea of *autrefois convict,* which shows that the judgment on the former indictment has been reversed for error in the judgment, is not a good bar to another indictment for the same offense. But a prior conviction before a justice of the peace, and a performance of the sentence pursuant to the judgment, constitute a bar to an indictment for the same offense, although the complaint on which the judgment proceeded was so defective that his judgment might have been reversed for error. The New York Code of Criminal Procedure, § 9, expressly prohibits a second prosecution for the same crime. At common law it is necessary, according to the weight of authority in a majority of the United States, to specially plead former conviction or acquittal. In many of the States, however, by statute, the plea of *autrefois acquit* may be taken advantage of under the plea of not guilty. The statute adopted in New York is similar in its terms to that of many other States. It is provided by the New York Code of Criminal Procedure, § 322, that a plea of former judgment of conviction or acquittal of the crime charged may be pleaded with or without the plea of not guilty. Consult Blackstone, 'Commentaries' and the authorities referred to under CRIMINAL LAW.

AUTUMN, the season of the year which follows summer and precedes winter. Astronomically, it is considered to extend from the autumnal equinox, 22 September, in which the sun enters Libra, to the winter solstice, 22 December, in which it enters Capricorn. In popular speech it includes in America the months of September, October and November, and in England August, September and October. In the southern hemisphere the seasons are, of course, reversed, and autumn extends from 22 March to 22 June.

AUTUN, ō-tęn, France (ancient *Bibracte*), a town in the department of Saône-et-Loire, of considerable interest both from its antiquities and from its modern edifices. Of the former the more remarkable are two Roman gates of exquisite workmanship and in good preservation, the ruins of an amphitheatre and of several temples; of the latter the most conspicuous is the cathedral of Saint Lazare, a Gothic structure of the 11th century. In Roman times it contained a famous school of rhetoric. The town contains a college, several museums and a library. It is an important manufacturing centre. Cloth, carpets, furniture, leather, paper and machinery are the principal articles of manufacture. Consult Lewis, 'The Antiquities of Autun' (in *Archæological Journal,* Vol. XI, London 1883). Pop. (1911) 15,498.

AUTUNITE, a beautiful canary-yellow mineral, occurring in thin, tabular crystals of orthorhombic symmetry, but closely approaching the tetragonal mineral torbernite in form. Both of these minerals are hydrous phosphates of uranium, but while calcium is an essential constituent of autunite, whose formula is $Ca(UO_2)2P_2O_8+8H_2O$, it is replaced by copper in torbernite, which is further distinguished by its green color. Autunite has eminent basal cleavage, resulting in a pearly lustre on the basal plane, while on the edges of the crystal the lustre approaches adamantine. It has a hardness of 2 to 2.5 and a specific gravity of about 3.12. Some autunite is beautifully fluorescent. Its name is derived from its most noted locality, Autun, France, where it is found in closely aggregated masses of crystals. Other noteworthy occurrences are in Cornwall, England, in Saxony, North Carolina and South Dakota.

AUVERGNE, ōvärn', France, a province of central France, now included in the departments Cantal, Puy-de-Dôme and Haute Loire. The mountains of Auvergne are the highest in the interior of France, the highest of them, Puy-de-Dôme, being 4,805 feet above the sea. It is entirely composed of volcanic matter, and has a regular crater 1,000 feet in circumference, and 300 feet deep. The whole of the cones present the same general character — well-defined craters enclosed by regular cones, on whose sides the lava currents may be traced as easily as on those of Vesuvius. The inhabitants are a simple and laborious people and are accustomed to emigrate each year after the harvest in large numbers to the neighboring regions, or to flock to the great industrial centres of France in search of employment, returning to their homes with their earnings in spring. The region was inhabited in ancient times by the powerful tribe of the Arverni, who ruled over a large part of Aquitania. In the Middle Ages Auvergne was a county. It was permanently united with the French crown in 1532.

AUVERGNE, Mountains of, a branch of the Cevennes, chiefly situated in the departments of Puy-de-Dôme and Cantal (France). The most important peaks are Puy-de-Sancy (6,185 feet), Plomb du Cantal and Puy-de-Dôme.

AUWERS, ou'vērs, **Arthur,** German astronomer: b. Göttingen, 12 Sept. 1838. He became assistant in the observatory at Königsberg in 1859, and at Gotha in 1862; in 1866 was made a member of the Berlin Academy and astronomer to it. In 1878 he was made permanent secretary of the section on physics and mathematics of the Academy. In his capacity of president of the Astronomical Society he was conspicuously identified with the preparation of the great co-operative catalogue of over 100,000 stars. He was also on the editorial staff of the *Vierteljahrsschrift* of the German Astronomical Society. He did important work in connection with the Venus transits of 1874 and 1882.

Other important services were the completion of Herschel's nebular observation, heliometric investigations in stellar astronomy, observations of the proper motion of fixed stars. For his services to astronomy he was made a foreign member of the Academy of Sciences at Washington, from which he also received the Watson gold medal. Among his works are 'Neue Reduktion der Bradleyschen Beobachtungen 1750–62' (1882–1903) and 'Katalog von 9,789 Sternen' (1896). In 1903 appeared 'Vierzehn unbekannt gebliebene Königsberger Zonen und Catalog von 1309 darin beobachteten sternen für das Aequinoctium 1825.'

AUX CAYES, ō-kā', Haiti, a seaport town situated on the southwest coast of the island, about 85 miles west of Jacmel. It has an excellent harbor, a good export trade and is the seat of an American consular agent. Pop. about 25,000.

AUXANOMETER, an instrument for recording the growth of plants during intervals too short for direct measurement. A simple form often used consists of a light, well-balanced lever, the fulcrum of which is so placed that the length of the long arm is a multiple of that of the short arm. To the latter a thread from the growing plant is attached. The long arm traverses a graduated arc from which its movement may be read, the growth of the plant being magnified in the ratio of the long arm to the short. A more elaborate instrument has been devised consisting of a wheel with fine bearings and a well-balanced rim grooved to receive a thread. The hub carries a smaller wheel with a grooved rim, whose diameter is one-tenth or one-twentieth that of the larger. The wheel is placed on a stand and the plant placed beneath it. A silk thread is attached to the plant, carried over the smaller rim and weighted sufficiently to rotate the hub as the plant grows. A thread is also placed on the larger rim with a counterweight at one end and a marker at the other. A recording apparatus made of a cylinder bearing smoked paper is driven by clockwork and the marker is placed so as to bear against the paper. Other methods of driving the cylinder are in use, of which one of the best is that in which the cylinder is released at regular intervals and allowed to rotate a short distance. The cylinder release is performed by means of an electro-magnet, the circuit being made by a clock at the proper intervals.

AUXERRE, ō-zār, France, capital of the department of Yonne, 90 miles southeast of Paris, on the Yonne. It is irregularly built on the slope of a hill and its streets are narrow. It contains an episcopal palace, now the residence of the prefecture, also the 13th century cathedral of Saint Etienne, one of the most imposing Gothic structures in France. Other noteworthy churches are those of Saint Germain and Saint Pierre. The town was formerly surrounded by walls but these have been converted into boulevards. A hospital rests on the site of the ancient abbey of Saint Germain and there are a college, a museum of antiquities and a botanic garden. Calico, serge, woolens, leather, earthenware and wine are manufactured and there is considerable trade in these products and also in timber and charcoal. The Yonne is navigable from here and barges transport quantities of Burgundy wines to Paris. Auxere was flourishing even in the pre-Roman days. It successfully resisted Attila and was taken by Clovis from the Romans. Later it formed part of the kingdom of Burgundy, was taken by the English in 1359, but was retaken by the renowned Du Guesclin. It was united to France by Louis XI. It was bombarded by the Germans in 1870. It is the birthplace of Jacques Amyot, who became bishop of the see and who is best known for his translation of Plutarch. Consult Freeman, 'Sens and Auxerre' (in *Archæological Journal,* Vol. XXXIX, London 1882). Pop. (1911) 21,929.

AUXONNE, ō-sŭn' (Latin *Asona* or *Aussona*), France, a town 18 miles east-southeast of Dijon, on the left bank of the Saône, here crossed by a beautiful bridge of 23 arches. Auxonne is well built, the seat of a court of commerce, and has a communal college, and a public library containing 4,000 volumes; a castle, an arsenal and a cannon foundry. Cloth, plaster of Paris, bricks, leather, etc., are manufactured here and there is a large trade in grain, lumber and vegetables. Pop. (1911) 6,303.

AUZOUT, ō-zoo', **Adrian,** French mathematician: d. 1691, inventor of the micrometer, still in use among astronomers to measure the apparent diameter of celestial bodies. He was the first who thought of applying the telescope to the astronomical quadrant.

AUZOUX, Théodore Louis, French surgeon: b. Saint Aubin d'Ecroville, Cure, 1797; d. 1880. He was the inventor, or the first to make those life-size and accurately colored anatomical models which are now used universally all over the world in medical colleges and schools of anatomy.

AVA, ä'vą, or **AUNGWA,** a town in Asia, the former capital of Ava or Birmah, on the Irrawaddy. It has a circuit of about five miles, and consists of an inner and an outer town, each surrounded by a brick wall. The city was reduced to ruins by an earthquake in 1839. Several Buddhist temples with gilded domes are the sole remains of its former glory. Consult Grant, 'Two Years in Ava' (London 1827). The present population is small.

AVA, ARVA, YAVA or **KAVA** (*Piper methysticum*), a plant of the natural order *Piperaceæ,* possessing narcotic properties. It is a shrubby plant, with heart-shaped acuminate leaves, and very short, solitary, axillary spikes of flowers. It is a native of many of the South Sea Islands where the inhabitants intoxicate themselves with a fermented liquor prepared from the upper portion of the root and the base of the stem. The rhizone is thick, woody, rugged and aromatic. The intoxicating liquor is prepared by macerating it in water. The narcotic property is ascribed to an acrid resin, *kawine,* present in the root. The taste is unpleasant to those unaccustomed to it, and has been likened to that of rhubarb and magnesia. The intoxication is not like that produced by ardent spirits, but rather a stupefaction like that caused by opium. It is succeeded by a copious perspiration. The habitual use of ava causes a whitish scurf on the skin, which, among the heathen Tahitians, was

reckoned a badge of nobility, the common people not having the means of indulgence requisite to produce it. Ava is, like cocaine, a local anæsthetic.

AVADHUTA, ä'vạ-d'-hoo'tạ, a member of a mendicant sect in southern India addicted to self-torture. They abandon all worldly restraints and religious observances and have their passions under complete control.

AVAL ISLANDS. See BAHREIN.

AVALANCHE, a mass of snow or ice which slides down steep mountain slopes. On lofty mountains snow would accumulate indefinitely if the excess were not removed by sudden falls or by glaciers which bring it into the valleys, where it melts. Avalanches may occur at any season of the year, but they are most frequent in early spring after the snow has begun to melt from the sun's rays. The water which collects beneath the snow bank loosens it from the ground, and the whole mass may then be precipitated to the base of the mountain. Such avalanches occur regularly in the Alps, where they are known as *grundlawinen.* Another type (*staublawinen*) occurring in the winter season is characterized by the dry and finely divided condition of the snow, and results from the overloading of the snowfields. A third class is the ice-avalanche, occurring along the course of glaciers. Avalanches are often very destructive, sweeping away trees, houses and everything in their path. Their destructive effects are greatly increased by the wind-blasts which accompany them. Those occurring in winter usually cause the greatest loss of life, as they develop suddenly and without warning; those that take place in spring generally follow a definite path and are more or less regular in their occurrence. The planting of forests on the high slopes sometimes affords protection from avalanches, but when this is not feasible, stone structures are employed.

AVALLENAU, a legendary poem, by some believed to have been written by Merlin. The theme is based on an old tradition, or folklore tale, to the effect that a band of knights were transformed into spirits in the Wood of Celyddon. The name probably has a common origin with Avalon (q.v.), which was the paradise of the heathen Celts.

AVALON, Cal., a summer resort on Santa Catalina Island, one of the "tent cities" peculiar to California, made possible by the long dry seasons. Instead of the seaside cottages familiar in other climates, the dwellings are entirely of canvas, some of them being quite elaborate, with many rooms, running water, etc. Lighting, water, a sewage system and other conveniences are provided as in other communities. During the summer months the population of Avalon sometimes exceeds 40,000, dwindling to less than 1,000 during the winter.

AVALON, Pa., borough of Allegheny County, five miles west of Pittsburgh, on the Ohio River, and on the Pittsburgh, Fort Wayne and Chicago Railroad. It is a residential suburb of Pittsburgh. Pop. 4,317.

AVALON, the legendary elysium of King Arthur, being his abode after disappearing from the haunts of men; called also Avilion. The name is also identified with Glastonbury, and has been given to a peninsula of Newfoundland. Avalon appears to have been the Celtic paradise. The origin of the name is doubtful. Consult Rhys, J., 'Studies in the Arthurian Legend' (Oxford 1891); and Meyer and Nutt, 'Voyage of Bran' (2 vols., London 1897).

AVALOS, ä'vạ-lōs', the name of a noble Neapolitan family, which included Ferdinand D'Avalos, Marquis de Pescara: b. Naples 1490; d. 30 Nov. 1525. He served with distinction in the army of Charles V, and was taken prisoner by the French at the battle of Ravenna in 1512. He beguiled the hours of captivity by writing a 'Dialogue of Love,' which he dedicated to his wife, the beautiful and accomplished Vittoria Colonna. He soon recovered his liberty, and subsequently displayed extraordinary ability in the wars of Charles V, notably at Pavia in 1525, where he was severely wounded.

AVANCINI, Nicholas, an ascetic writer of the Society of Jesus: b. 1612; d. 1686. His little book of meditations on the life and doctrine of Jesus Christ which has been translated into several languages and is widely used to-day by members of clergy first appeared in Vienna in 1665. By reason of its arrangement, its scriptural sources, its pithy suggestiveness and its practical character, Cardinal Gibbons states that it has been his Vade Mecum, his book of meditations during all the years of his ministry.

AVARE, L', la-vär' (The Miser), the title of one of the most famous of Molière's prose comedies, first produced 9 Sept. 1668. It is founded on the 'Aulularia' of Plautus, and was paraphased by Fielding in his comedy of 'The Miser.' Harpagon is a sexagenarian miser who incarnates the spirit of avarice and has determined to marry a young woman named Mariane, but ultimately prefers his gold to matrimony.

AVARS, ä'värz, or **AVARES,** a nation of Mongolian or Turkish origin, which at an early period migrated to the regions around the Don, the Caspian Sea and the Volga. They served in Justinian's army, and later made themselves masters of Dalmatia, pressed into Thuringia and Italy, where they fought with the Franks and Lombards, and extended their dominion over the Slavonians dwelling on the Danube and farther north, as well as over the Bulgarians on the Black Sea. In 640 they were driven out of Dalmatia and confined to Pannonia. They were at length overcome by Charlemagne, and after 827 disappear from history; but the valley of Erlav, a small tributary of the Danube in Lower Austria, was called the "land of the Avars" as late as the 10th century. The name is also borne by a tribe estimated to number upward of 100,000, now living in the Caucasus Mountains, noted for their struggle with Russia, in which they were led by Schamyl (q.v.). They are followers of Islam and have a written language with Arabic characters. Consult Deniker, 'Races of Man' (1900); and Keane, 'Ethnology' (London 1896).

AVARY, Myrta Lockett, American writer and sociologist: b. Halifax, Va. For several years she was an editorial writer on various publications, then became interested in settle-

ment work. She is the author of 'Dixie After the War' (1906); 'Joel Chandler Harris and His Home' (1913); 'Letters and Recollections of Alexander H. Stephens' (edited 1910).

AVATAR, ăv'ą-tär', in Hindu mythology, an incarnation of the Deity. Ten avatars are peculiarly distinguished, and four of them are the subjects of *Purânas,* or sacred poems. These 10 are among the incarnations of Vishnu, the supreme God. The Matsya avatar was the descent of the Deity in the form of a fish; Kachyapa or Kûrma, in that of a tortoise; Varâha, as a boar; Nara-sinha, as a monster, half man, half lion; Vàmana, as a dwarf; Parasurama, as the son of Jamadagni. All these took place in the *Satya Yuga,* or Golden Age. The seventh incarnation was in the form of the four sons of King Dasaratha, under the names of Râma, Lakshmana, Bharata and Satrughna, in order to destroy certain demons that infested the earth. The achievements of Râma form the subject of the celebrated epic called the Râmâyana. The eighth avatar of Vishnu, in the form of Krishna, is the best known of all, from the fact that it forms the subject of the great Sanskrit epic poem, the Mahâhbârata. Its object was to relieve the earth from the Daityas, and the wicked men who oppressed it. The ninth was in the form of Buddha. The Kalki, or tenth avatar, is yet to come at the end of the *Kali Yuga,* or the Iron Age. See VISHNU.

AVATCHA, ą-vä'chą, a volcano and bay in Kamchatka in lat. 53° 18′ N. and long. 158° 47′ E. The volcano, 9,000 feet high, was last active in 1855. The largest crater is several hundred yards in circumference. The town of Petropavlovsk is situated on the bay.

AVE-LALLEMANT, a'vā'lą'mān', **Friederich Christian Benedict,** German criminologist: b. Lübeck, 23 May 1809; d. Berlin 1892. After graduating from Jena, he began practising law in his native town. From 1851 to 1868 he was a police magistrate. His most important work is 'Das deutsche Gaunertum' (4 vols., Leipzig 1858–62). It consists of a detailed history of crime and its punishment in Germany and includes a dictionary of the slang words used among criminals. He is also the author of some fiction, most of it being in the nature of detective stories.

AVE-LALLEMANT, Robert Christian Berthold, brother of Friederich Christian Benedict Ave-Lallemant, German physician and writer: b. Lübeck, 25 July 1812; d. there, 13 Oct. 1884. For the greater part of his life he was a practising physician in Rio de Janeiro, Brazil. He is the author of 'Reise durch Südbrasilien' (2 vols., 1859); 'Reise durch Nordbrasilien' (2 vols., 1860); 'Fata Morgana' (1872); 'Wanderungen durch die Pflanzenwelt der Tropen' (1880).

AVE MARIA, ä'vā mą-rē'ą (Latin; hail Mary; from *avere*); among the Roman Catholics the beginning of a prayer to the Virgin, whence the whole prayer is called *Ave Maria.* It is the beginning of the salutation which the angel addressed to the Virgin, as he announced to her that she should be the mother of the Saviour and the address to her of her cousin Elizabeth (Luke i, 28, 42; "Hail, highly favored, the Lord is with thee blessed are thou among women"). See ROSARY.

AVEBURY, ā'bėr-ĭ, 1st baron. See LUBBOCK, JOHN.

AVEBURY, England, village in Wiltshire, noted for its Druidical temple, which originally consisted of a larger outer circle of 100 stones, from 15 to 17 feet high, and about 40 feet in circumference, surrounded by a broad ditch and lofty rampart, and enclosing two smaller circles. On the neighboring downs are numerous barrows or artificial tumuli, one of which, called Silbury Hill, rises to the height of 130 feet, with a circumference of 2,027 feet at the base, covering an area of more than five acres. Sir John Lubbock the scientist selected his title of Lord Avebury from the name of this village.

AVEIRO, ą-vĕ-ę-roo, Portugal, a seaport and the capital of an administrative district, on the Vouga, and the Lisbon-Oporto Railway. Aveiro is built on the southern shore of a marshy lagoon, containing many small islands, and measuring about 15 miles from north to south, with an average breadth of about one miles. The Barra Nova, an artificial canal about 33 feet deep, constructed 1801–08, gives access to the Atlantic Ocean. The local industries include the preparation of sea-salt, the catching and curing of fish, especially sardines and oysters, and the gathering of aquatic plants. There is also a brisk trade in wine, oil and fruit; while the Aveiro district contains copper and lead mines, beside much good pasture land. Pop. 10,000.

AVELING, Francis Arthur Powell, Canadian clergyman and author: b. Saint Catherine's, Ontario, 1875. He was educated at Keble College, Oxford, the Canadian College, Rome, and at Louvain University. Becoming a convert to the Roman Catholic faith in 1896 he was ordained to the priesthood in 1899 and became first rector of the Cathedral Choir School at Westminster. He was also appointed lecturer in analytical psychology at University College, London, and after the outbreak of the great war became chaplain of the forces. He is a fellow of Louvain University; extern examiner in philosophy, National University of Ireland, and lecturer in pedagogical methods, London County Council. He has published 'The Philosophers of the Smoking Room'; 'The God of Philosophy'; 'On the Consciousness of the Universal and the Individual'; etc. He is a contributor to the Dublin *Review,* the *American Catholic Quarterly Review,* the *Review Néo-Scholastique,* the *Nineteenth Century, Journal of Psychology,* etc.

AVELLANEDA, ą-vā'lyą-nā'da, **Alfonso Fernandes de,** the pseudonym of the writer of a sequel to 'Don Quixote,' issued prior to the sequel by Cervantes. The real name of the author is not known but the work has been ascribed to about a dozen different writers. See DON QUIXOTE.

AVELLANEDA, Nicholas, Argentine statesman: b. Tucuman, 1 Oct. 1836; d. 26 Dec. 1885. He was professor of political economy in the University of Buenos Aires; Minister of Public Instruction in 1868–74, and President of the republic in 1874–86. He published several historical and economical works.

AVELLANEDA Y ARTEAGA, ą-vā'lyą-nä'da ē är'tā-ä'gą, **Gertrudis Gomez de,** Spanish

poet, dramatist and novelist: b. Puerto Principe, Cuba, 23 March 1814; d. Madrid, 2 Feb. 1873. Under the pseudonym Peregrina she contributed to Andalusian journals many 'Lyric Poems' (1851–54), and afterward wrote a series of spirited novels: 'Two Women,' 'The Baroness de Joux,' 'Dolores,' and others. She gained still higher distinction with the tragedies 'Alfonso Munio,' the hero of which was her own ancestor, and 'The Prince of Vianna.' Her later compositions had a tone of melancholy; among these are Biblical dramas, as 'Saul' and 'Balthasar'; the spiritual song, 'At the Cross,' and 'The Last Ascent of My Harp' (1850). In the later years of her life she composed 16 plays which still have a place on the Spanish stage. She is without a rival of her sex among Spanish writers of the 19th century. Some critics hold that she was second only to Christina Rossetti among modern poetesses. Her 'Alvas literarias' begun to appear at Madrid in 1869 but only five volumes have been issued. See SAB (or ESPATILINO).

AVELLINO, ä'vĕl-lē'nō, **Francesco Maria,** Italian archæologist: b. Naples, 14 Aug. 1788; d. 10 Jan. 1850. He was at first professor of Greek literature at the University of Naples, during which period he was also the tutor of the children of Murat. In 1820 he became professor of political economy at the same institution. In 1839 he became director of the Real Museo Borbonico, of whose vast coin collections he had previously prepared a valuable catalogue. He was also the founder of the journal *Bollettino Archeologico.* His chief works are collected under the title 'Opuscoli diversi' (Naples 1831–36, 3 vols.).

AVELLINO, a town in Italy, 29 miles east of Naples. It has a square adorned with an obelisk, and possesses several agreeable promenades. Avellino has several fine monuments, an academy and a theatre. Cloths, hats, shoes and chairs are manufactured. Chestnuts and hazel nuts have been gathered in the vicinity since Pliny's day. The ruins of ancient Abellinum are about three miles distant and here also is the famous convent of Monte Vergine, which is visited annually by tens of thousands of pilgrims. Pop. (1911) 23,926.

AVEMPACE, ävąm-pä-thą, **Ibn Bajja,** Arabic poet and philosopher: b. Saragossa, Spain, about the end of the 11th century; d. Fez, 1138. At first he held high office in his native city, but finally lost his position on account of his liberal attitude in regard to religion. After residing at various times in Seville and Granada, he finally arrived in Fez, where he became court physician to the Sultan. He died from poison administered by a jealous rival for the favor of the Sultan. Avempace belonged to that broad school of Arabic philosophy which ignored the letter of the Koran. Beside his commentaries on Aristotle, he made known the Peripatetic school of philosophy in Spain. He also wrote several works on medicine and music and composed many original poems. Consult Brockelmann, 'Geschichte der arabischen Litteratur' (Weimar 1899).

AVENA. See OATS.

AVENARIUS, Ferdinand, German poet and critic, nephew of Richard Wagner: b. Berlin, 20 Dec. 1856. After studying at the universities of Leipzig and Zürich, he founded the art journal *Kunstwart,* which finally became the leading publication of its kind in Germany. He was also the editor of a collection of reproductions of works of art. His critical works are 'Deutsche Lyrik der Gegenwart' (2d ed., 1884); 'Max Klinger's Griffelkunst' (2d ed., 1907); 'Balladen Buch' (1907 and 1910); 'Das fröliche Buch aus deutscher Dichter und maler Kunst gesammelt' (1910). His poetical works are the idyl 'Die Kinder von Wohldorf' (6th ed., 1910); 'Lebe' (8th ed., 1909); 'Stimmen und Bilder' (7th ed., 1910); 'Hausbuch deutscher Lyrik' (10th ed., 1910).

AVENARIUS, Richard, German philosopher: b. Paris 1843; d. Zürich 1896. He studied philosophy at the universities of Zürich, Berlin and Leipzig, and from 1877 to his death was professor of philosophy at Zürich. He wrote on Spinoza's pantheism, published a theory of experience and contributed many papers to magazines and reviews, upon philosophical subjects. He also wrote 'Kritik der reinen Erfahrung' (2 vols., Leipzig 1889, 1907). Consult Bush, W. T., 'Avenarius and the Standpoint of Pure Experience' (New York 1905); and Ewald, O., 'Richard Avenarius als Begründer des Empiriokritizismus' (Berlin 1905).

AVENCHES, ą-vänsh', Switzerland, a town in the canton of Vaud, seven miles northwest of Friburg. It is the ancient Aventicum, capital of Helvetia under Roman rule, and is noted for its Roman relics, notably the ruins of an amphitheatre, and a Corinthian column belonging to a temple of Apollo. This column, celebrated by Byron in 'Childe Harold' (3d canto, 65th line), is known as Le Cicognier, from the fact that for centuries storks have used it as a nesting place. In Roman times it was a city of 20,000 inhabitants. Avenches is the German Wiflisburg (castle of Wiflis, a count of Burgundy of the 7th century). The castle is built on the site of the Roman Capitol, and there is a museum in the amphitheatre. The population now is about 2,000.

AVENEL, Mary, a character appearing in Scott's novels, 'The Monastery' and 'The Abbot.'

AVENGER OF BLOOD, among primitive peoples the next of kin to a murdered man, upon whom was laid the duty of avenging the crime by killing the murderer. In this custom may be detected the source of the system of criminal law. Primitive law is concerned solely with crimes of violence — homicides, wounding and robbery. The punishment is left to the injured party or to his kinsman. In course of time the right of the kinsman was limited by the doctrine of sanctuary, and by the institution of the wergild, whereby a money payment was made to the avenger of blood in commutation of the natural penalty of the crime. Among the Arabs these primitive customs survive and the hereditary feuds of families, clans and tribes in semi-barbarous countries are survivals of this same institution.

AVENTINE, the southernmost of the seven hills of Rome, on the left bank of the Tiber, between the river and the Cælian hill. The Circus Maximus lay to the northeast of the Aventine, between it and the Palatine, and

the baths of Caracalla were on the southeast. Servius Tullius included it in the city and it was settled by the plebs in 455 B.C. Consult Platner, 'Topography and Movements of Ancient Rome' (New York 1911).

AVENTINUS, the name taken by Johann Turmair, Bavarian historian: b. Abensberg, 4 July 1477; d. Regensburg, 9 Jan. 1534. He studied at Ingolstadt, Vienna, Cracow and Paris, and in 1509 was appointed tutor to Louis and Ernest, the two younger sons of Albert the Wise, the late Duke of Bavaria-Munich. Encouraged by William IV, Duke of Bavaria, he began to write the 'Annales Bojorum' about 1517, and finishing this book in 1521, undertook a German version of it, which he completed some years later. He assisted to found the Sodalitas litteraria Angilostadensis, under the auspices of which several old manuscripts were brought to light. The 'Annales' deals with the history of Bavaria in conjunction with general history from the earliest times to 1460. He took immense pains with his work, and to some degree anticipated the modern scientific method of writing history. Aventinus, who has been called the "Bavarian Herodotus," wrote other books of minor importance.

AVENTURINE. See QUARTZ.

AVENZOAR, ä'vĕn-zō'ăr, or more correctly, **ABU-MERWAN-MOHAMMED-BEN-ABDALMALEC-BEN-ZOHAR,** Arabian physician of the 12th century: b. Seville, Spain, about 1072; d. Morocco 1162. He became eminent in his profession, traveled much, and passed through many adventures, among which was a long imprisonment at Seville. He had the care of a hospital, and composed a work entitled 'Al Theiser,' containing a compendium of medical practice, and including many facts and observations not found in the preceding writers, which was probably the result of his own experience. He was an advocate of the experimental method, had a remarkable knowledge of anatomy and tried many experiments. He introduced a silver tube for the introduction of food into the stomach. He influenced Averroes, who attended some of his lectures. His work, 'The Method of Preparing Medicines and Diet' was translated into Hebrew (1280) and into Latin (1490). The report of his having lived to the age of 135 is probably an error arising from his having been confounded with his son, of the same name and profession, who lived at Morocco, and was the author of a treatise on the regimen of health.

AVERAGE, in maritime law, is general, particular or petty. General average (also called gross) consists of expense purposely incurred, sacrifice made or damage sustained for the common safety of the vessel, freight and cargo, or the two of them, at risk, and is to be contributed for by the several interests in the proportion of their respective values exposed to the common danger, and ultimately surviving, including the amount of expense, sacrifice or damage so incurred in the contributory value. Indemnity for general average loss is ordinarily stipulated for in policies against the risks in navigation, subject, however, to divers modifications and conditions. Under maritime policies in the usual form, insurers are liable for the contributions, for loss by jettison of cargo, sacrifice of cables, anchors, sails, boats, delay for the purpose of refitting, voluntary stranding, etc. Average particular (also called partial loss) is a loss on the ship, cargo or freight, to be borne by the owner of the subject on which it happens, and is so called in distinction from general average, and, if not total, it is also called a partial loss. It is insured against in marine policies in the usual forms on ship, cargo or freight, when the action of peril is extraordinary, and the damage is not mere wear or tear, and on the ship covers loss by sails split or blown away, masts sprung, machinery of steamship disabled, planks started, change of shape by strain, loss of boat, breaking of sheathing or upper works or timbers, damage by collision or stranding, by lightning or fire, or in defense against pirates or enemies, or by hostile or piratical plunder. Petty average consists of small charges formerly assessed upon the cargo, to wit: anchorage, pilotage, beaconage, towage, quarantine, etc. See MARINE INSURANCE.

AVEREHENKO, Arkadi Timofeye'vich, ä-vĕr-chĕn'ko, Russian humorist writer: b. 1881. He was the son of a merchant. He started on his career with a position in the office of some works of mines. In 1907 he edited the periodical *Shtuik* and since 1908 has been editing *Satirikon* (formerly *Strekoza*). He contributed to the collection 'Utro' and to the periodicals *Zhournal dlya Vsiekh, Zriteli* and others. His works are often published under the pseudonym AVE. Part of his humoristical tales have been edited in the collection 'Vesyeluiya Ustritzui' (Happy Oysters) (6th ed., 1911); 'Tales' (1910); 'Little Hares on the Wall' (1910).

AVERELL, William Woods, American military officer: b. Cameron, N. Y., 5 Nov. 1832; d. Bath, N. Y., 3 Feb. 1900. He was educated at West Point, and was graduated there in 1855, and served on the frontier, and in several Indian campaigns till the beginning of the Civil War, when he was appointed colonel of the 3d Pennsylvania Cavalry, and assigned to the command of the cavalry defenses of Washington. During the war he distinguished himself on numerous occasions as a cavalry raider and commander, and at its close was brevetted major-general of volunteers. In 1863–64 on his raids, he fought numerous skirmishes, destroyed many miles of railroad, captured great quantities of supplies and in various ways greatly hampered the Confederates and aided the Federal commands in carrying out their plans of campaign. He resigned from the regular army while holding the rank of captain, in 1865, and, under an act of Congress, was reappointed captain in August 1888, and was placed on the retired list in the same month. He was United States Consul-General at Montreal in 1866–69. He invented a system of asphalt pavement now quite generally adopted and the Averell insulating conduits for wires and conductors and a method of making cast steel direct from the iron ore in one operation.

AVERNUS, ą-vĕr'nŭs, a small circular lake, now called *Lago d'Averno,* in Campania, Italy, between the ancient Cumæ and Puteoli.

It is surrounded by hills of a moderate height, which used to be covered with immense woods, while the atmosphere was charged with unhealthful mephitic effluvia, and it occupies the crater of an extinct volcano. By ancient Greek writers, subsequent to Homer, it was fabled to be the entrance to the infernal regions, and to have been the place where Ulysses entered in his visit to the shades. It was also thought that the Cimmerians of Homer dwelt on the banks of this lake. The sibyl of Cumæ is said to have had her grotto here, and Virgil represents her as guiding Æneas when he made his descent (*"facilis descensus Averno"*) to the infernal regions at this place. The lake is about a mile and a half in circumference. Agrippa caused the woods to be thinned and made the lake a naval headquarters, known as Portus Julius. He had it connected by canal with Lacus Lucrinus and Cocceius constructed a famous tunnel to Cumæ through the mountain.

AVERROES, av-er-rōs' (corrupted from *Ebn* or *Ibn Roshd*), a renowned Arabian philosopher: b. Cordova, Spain, 1126; d. about 1198. He studied theology and philosophy under Tofail and medicine under Ibn Zuhr at Cordova. In 1169 he became a cadi or judge first in Seville and afterward in Cordova. He was accused of rejecting the established religion, and in consequence deprived of his offices, and fled to Fez. Here he was condemned by a spiritual court to recant and undergo a public penance. Upon this he went back to his own country, but was latterly restored to his dignities in Morocco. Averroes regarded Aristotle as the greatest of all philosophers, and explained his writings, with only a slight deviation from his views. Besides commentaries on Aristotle and other philosophical works he wrote also a compendium of physic, called 'Colliget' (a corruption of the Arabic 'Kulliyat,' or summary), and treatises on jurisprudence, astronomy, grammar, etc. His commentaries upon Aristotle, in a Latin translation, were repeatedly printed at Venice in the 15th and 16th centuries. His 'Colliget' also was early translated into Latin, and several times printed. Consult Brockelmann, 'Geschichte der arabischen Litteratur' (Vol. I, Weimar 1899); De Boor, 'History of Philosophy in Islam' (Leyden 1903); Renan, 'Averroës et l'averroisme' (Paris 1860); Müller, 'Philosophie und Theologie von Averroës' (1875).

AVERSA, a-vĕr'sa, Italy, a town 12 miles north of Naples, on a plain covered with vines and orange trees. It is the seat of a bishop, and is famed for a kind of almond-cake, called *torrone,* in great demand at Naples. It contains a cathedral and monasteries, an insane asylum and a foundling institution. It is also famed for *asprino,* a sparkling white wine, and for oil, fruit and silk. Nearby is the ancient Atella, whence came the coarse farces called *Atellanæ fabulæ.* The modern town was founded by the Normans in 1029. Pop. (1911) 23,203.

AVERY, Elroy McKendree, American writer: b. Erie, Mich., 1844. He served in the Federal army during the Civil War, and has since been prominent in educational matters. Among his many published works are textbooks in physics and chemistry, 'Words Correctly Spoken' (1887); 'A Popular History of the United States, and Its People' (12 vols.); 'The Town Meeting' (1904).

AVERY, Samuel Putnam, American art expert: b. New York, 17 March 1822; d. there, 12 Aug. 1904. After having studied engraving he began business as an art dealer in 1865. Two years later he was appointed commissioner in charge of the American art department at the Paris Exposition. He was one of the founders and for a long time a trustee of the New York Metropolitan Museum of Art (q.v.). He is also the founder of the Avery Architectural Library at Columbia University, which he gave as a memorial to his son, Henry Ogden Avery. Avery Hall, erected on the campus of Columbia University in 1912, is a memorial to both father and son.

AVERY'S GORES, the name of several tracts of land in Vermont, granted to Samuel Avery in 1791. One of them is in Addison County, nearly on the summit of the Green Mountains, now forming a part of Granville.

AVES, ā'vās, or **BIRD ISLANDS,** a group of small islands belonging to Venezuela, valuable for their deposits of guano.

AVES, ā'vēz, the class of vertebrated animals which contains the birds. They have been defined by Dr. Gadow as "oviparous, warm-blooded, amniotic vertebrates, which have their anterior extremities transformed into wings." The metacarpus and fingers carry feathers or quills; there is an intertarsal joint, and the feet have not more than four toes, of which the first is the hallux. See BIRDS.

AVESNES, ą-vān, France, the capital of an arrondissement in the department of Nord, on the Helpe, 28 miles southeast of Valenciennes. The town is the seat of a sub-prefect, and has a tribunal of first instance, a chamber of commerce and a communal college. The chief industry of the town is wool-spinning, and there is trade in wood. It was founded in the 11th century, and formed a countship which in the 15th century passed to the house of Burgundy. In 1477 it was destroyed by Louis XI. In 1659 it came into the possession of the French, and was fortified by Vauban. It was captured by the Prussians in 1815. Pop. about 6,000.

AVESTA, or **ZEND-AVESTA,** the Bible of Zoroaster, the sacred book of ancient Iran, and holy scripture of the modern Parsis. The exact meaning of the name "Avesta" is not certain; it may perhaps signify "law," "text," or, more doubtfully, "wisdom," "revelation." The modern familiar designation of the book as Zend-Avesta is not strictly accurate; if used at all, it should rather be Avesta-Zend, like "Bible and Commentary," as *zand* signifies "explanation," "commentary," and *Avesta u Zand* is employed in some Persian allusions to the Zoroastrian scriptures as a designation denoting the text of the Avesta accompanied by the Pahlavi version or interpretation. The story of the recovery of the Avesta, or rather the discovery of the Avesta, by the enthusiastic young French scholar, Anquetil du Perron, who was the first to open to the western world the ancient records of Zoroastrianism, reads almost like a romance. Du Perron's own account of

his departure for India in 1754, of his experiences with the *dasturs* (or priests) during a seven years' residence among them, of his various difficulties and annoyances, setbacks and successes, is entertainingly presented in the introductory volume of his work 'Zend-Avesta, Ouvrage de Zoroastre' (1771). This was the first translation of the ancient Persian books published in a European language. Its appearance formed one of those epochs which are marked by an addition to the literary, religious or philosophical wealth of our time; a new contribution was added to the riches of the West from the treasures of the East. The field thus thrown open, although worked imperfectly at first, has yielded abundant harvests to the hands of later gleaners. With the growth of knowledge of the language of the sacred texts, we have now a clear idea also of the history of Zoroastrian literature, and of the changes and chances through which with varying fortunes the scriptures have passed. The original Zoroastrian Avesta, according to tradition, was in itself a literature of vast dimensions. Pliny, in his 'Natural History,' speaks of 2,000,000 verses of Zoroaster; to which may be added the Persian assertion, preserved through Mohammedan writers, that the original copy of the scriptures was written upon 12,000 parchments, with gold illuminated letters, and was deposited in the library at Persepolis. But what was the fate of this archetype? Parsi tradition has an answer. Alexander the Great,—"the accursed Iskander," as he is called,—is responsible for its destruction. At the request of the beautiful Thais, as the story goes, he allowed the palace of Persepolis to be burned, and the precious treasure perished in the flames. Whatever view we may take of the different sides of this story, one thing cannot be denied: the invasion of Alexander and the subjugation of Iran caused, indirectly or directly, certain religious decadence which followed upon the disruption of the Persian empire, and was answerable for the fact that a great part of the scriptures was forgotten or fell into disuse. Zoroastrian tradition, found in Pahlavi sources, lays at the doors of the Greeks the loss of another copy of the original ancient texts that existed at Samarkand before Alexander's invasion; but has it any account to give of copies of the prophet's works which Semistic writers say were translated into nearly a dozen different languages. One of these versions was perhaps Greek, as the Pahlavi accounts state, for it is generally acknowledged that in the 4th century B.C. the philosopher Theopompus spent much time in giving in his own tongue the contents of the sacred Magian books.

Tradition is unanimous on one point at least: it is that the original Avesta comprised 21 *Nasks*, or books, a statement which there is no good reason to doubt. The same tradition which was acquainted with the general character of those Nasks professes also to tell exactly how many of them survived the inroad of Alexander; for although the sacred text itself was destroyed, its contents were lost only in part, the priests preserving large portions of the precious scriptures. These met with many vicissitudes in the five centuries that intervened between the conquest of Alexander and the great restoration of Zoroastrianism in the 3d century of our era, under the Sassanian dynasty. At this period all obtainable Zoroastrian scriptures were collected, the compilation was codified, and a detailed notice made of the contents of each of the original Nasks, comprising in all some 825 chapters, compared with the portions then surviving. The original Avesta was, it would appear, a sort of encyclopedic work; not of religion alone, but of useful knowledge relating to law, to the arts, science, the professions, and to every-day life. If we may judge from the existing table of contents of these Nasks, the zealous Sassanians, even in the time of the collecting (226–380 A.D.), were able to restore but a fragment of the archetype, perhaps a fourth part of the original Avesta. Nor was this remnant destined to escape misfortune. The Mohammedan invasion, in the 7th century of our era, added a final and crushing blow. Much of the religion that might otherwise have been handed down to us, despite "the accursed Iskander's" conquest, now perished through the sword and the Koran. Its loss, we must remember, is in part compensated by the Pahlavi religious literature of Sassanian days.

Fragmentary and disjointed as are the remnants of the Avesta, we are fortunate in possessing even this moiety of the Bible of Zoroaster, whose compass is about one-tenth that of our own sacred book. A grouping of the existing texts is here presented: (1) Yasna (including Gathas); (2) Visperad; (3) Yashts; (4) Vendidad (Vidēvdāt); (5) Minor Texts; (6) Fragments.

Even these texts no single manuscript in our time contains complete. The present collection is made by combining various Avestan codexes. In spite of the great antiquity of the literature, all the existing manuscripts are comparatively young. None is older than the 13th century of our own era, while the direct history of only one or two can be followed back to about the 10th century. This mere external circumstance has of course no bearing on the actual early age of the Zoroastrian scriptures. It must be kept in mind that Zoroaster lived at least six centuries before the birth of Christ.

Among the six divisions of our present Avesta, the Yasna, Visperad and Vendidad are closely connected. They are employed in the daily ritual, and they are also accompanied by a version or interpretation in the Pahlavi language, which serves at the same time as a sort of commentary. The three divisions are often found combined into a sort of prayer-book, called Vendidad-Sadah (Vendidad Pure); that is, Avesta text without the Pahlavi rendering. The chapters in this case are arranged with special reference to liturgical usage.

Some idea of the character of the Avesta as it now exists may be derived from the following sketch of its contents and from the illustrative selections presented:

Yasna (sacrifice worship), the chief liturgical work of the sacred canon. It consists mainly of ascriptions of praise and of prayer, and corresponds nearly to our idea of a prayer-book. The Yasna comprises 72 chapters; these fall into three nearly equal parts.

The greater part of the Yasna book is of a liturgic or ritualistic nature, and need not here be further described. Special mention, however, must be made of the middle section con-

sisting of "the Five Gathas" (hymns, psalms), a division containing the 17 sacred psalms, sayings, sermons or teachings of Zoroaster himself. These Gathas, all composed in verse that resembles the metres of the Veda, form the oldest part of the entire canon of the Avesta. In them the prophet of the new faith is speaking with the fervor of the Psalmist of the Bible. In them we feel the thrill of ardor that characterizes a new and struggling religious band; we are warmed by the burning zeal of the preacher of a church militant. Now, however, comes a cry of despondency, a moment of faint-heartedness at the present triumph of evil, at the success of the wicked and the misery of the righteous; but this gives way to a clarion burst of hopefulness, the trumpet note of a prophet filled with the promise of ultimate victory, the triumph of good over evil. The end of the world cannot be far away; the final overthrow of Ahriman (Anra Mainyu) by Ormazd (Ahura Mazda) is assured; the establishment of a new order of things is certain; at the founding of this "kingdom" the resurrection of the dead will take place and the life eternal will be entered upon.

The *Visperad* (all the masters) is a short collection of prosaic invocations and laudations of sacred things. Its 24 sections form a supplement to the Yasna. Whatever interest this diversion of the Avesta possesses lies entirely on the side of the ritual, and not in the field of literature. In this respect it differs widely from the book of the Yashts, which is next to be mentioned.

Yashts (worship by prayers and ascriptions of praise) form a poetical book of 21 hymns, in which the angels of the religion, "the worshipful ones" (*Yazatas, Izads*), are glorified as are also the heroes of former days. Much of the material of the Yashts is evidently drawn from pre-Zoroastrian sagas which have been remodeled and adopted, worked over, and modified and incorporated into the canon of the new-founded religion. There is a mythological and legendary atmosphere about the Yashts, and Firdausi's 'Shah Nameh' serves to throw light on many of the events portrayed in them, or allusions that would otherwise be obscure. All the longer Yashts are in verse, and some of them have poetic merit.

Vendīdād, or more correctly *Vidēvdāt*, 'Law against the Demons' is a priestly code comprising 22 chapters and somewhat resembles the Biblical Pentateuch. It consists morally of purificatory rules to be observed for removing defilement, especially the pollution incurred through coming into contact with dead matter. It contains likewise some old myths, legends and beliefs.

Minor Texts, as a section of the Avesta, form a small group of liturgical texts containing brief prayers, litanies and blessings to be recited daily or repeated on special occasions.

Fragments of other portions of the Avesta are preserved, like *Ērpatistān, Nirangistān* and *Aogemadaēca*, and among them is a noteworthy one from the original *Hadhōkht Nask* describing the fates of the soul after death.

There are several translations of the Avesta. The best (except for the Gathas, where the translation is weak) is the French version by Darmesteter, 'Le Zend Avesta,' published in the 'Annales du Musée Guimet' (Paris 1892–93). An English rendering by Darmesteter and Mills is contained in the 'Sacred Books of the East' (Vols. IV, XXIII, XXXI). To be consulted also is the German translation of the Gathas by Bartholomae (Strassburg 1905), forming the basis of the English version by Moulton, 'Early Zoroastrianism' (pp. 341–90, London 1913); likewise F. Wolff, 'Avesta üversetzt' (Strassburg 1910); and an Italian translation of the Vendidad by Cannizzaro, 'Il Vendidad' (Messina 1916).

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AVEYRON, a'vā-rôn', France, a department in the south. It is extremely mountainous, and is traversed by five considerable rivers, the Aveyron, after which the department is named, the Viaur, the Truyère, the Lot and the Tarn. Of these, the only one navigable within the department is the Lot. It is only in the west that plains of any considerable extent are found. Agriculture is in a very defective state, north of the Lot, only rye and oats are grown, but considerable attention is paid to sheep-breeding. Cheese of an excellent quality is made and exported in large quantities. Aveyron possesses valuable coal, iron and copper mines, besides other minerals. Other leading industries include the manufacture of woolen goods, leather and machinery. Pop. (1911) 369,448. Capital, Rodez.

AVEZAC DE CASTERA MACAYA, a'v'-ząk mą-kī-yą, **Marie Armand Pascal d'**, French geographer: b. Tarbes, 18 April 1800; d. 14 Jan. 1875. He began practising law in Paris. He soon gave up this profession for a position in the Ministry of Marine, but soon devoted himself entirely to his favorite study, being especially interested in Africa and the early discoveries on the American continent. He was six times president of the Geographical Society of Paris and one of the founders of the Ethnological Society of Paris. His chief works are 'Essais historiques sur le Bigorre' (1823); 'Etudes de geographie critique sur l'Afrique septenrionale' (1837); 'Esquisse générale de l'Afrique et l'Afrique ancienne' (1844); 'Iles de l'Afrique' (1848); 'Les iles fantistiques de l'Océan occidental au moyen-âge' (1845); 'Notice sur le pays et le peuple de Yebous' (1845); 'Les voyages d'Améric Vespuce' (1860); 'Le livre de Fernand Colombe' (1873).

AVEZZANO, ā'vĕt-sā'nō, **Giuseppe**, Italian adventurer: b. Chieri, Piedmont, 1789; d. Rome, 25 Dec. 1879. Entering the army in 1805, he fought under Napoleon and in 1814 was made a lieutenant in the Sardinian army. For complicity in the rising of 1821 he was condemned to death, but managed to escape to Spain, where he enlisted under the Constitutionalist flag. He was finally captured by the French, who exiled him to America. Arriving in Mexico he settled in Tampico and engaged in business. Presently his military experiences gained him a commission in the Mexican army. In 1848 he returned to Italy. Here he was Minister of War of the Roman Republic in 1849. After the collapse of the republic a few months later he returned to the

United States, where he again engaged in business. Later he joined Garibaldi's expedition, and fought under him at Volturno. Later he was a radical deputy in the new Italian Parliament. Before his death he became one of the most active leaders of the Irredentists.

AVIARY, a house or enclosure, larger than an ordinary cage, for living birds. Out-of-door aviaries are common in the warm countries of southeastern Europe and in Asia, and are also quite numerous in England. The freedom of motion possible for a bird in a good-sized aviary helps to keep them in good condition, and many species which are unable to bear the close confinement of a cage flourish in the larger enclosures. In a climate like that of the United States, where extremes of temperature are great, outdoor aviaries are uncommon except in zoological gardens. In the New York Zoological Park is an aviary built in 1900, measuring 153 feet long, 72 feet wide and 55 feet high; at present this is the largest in the world. It is a wire cage, in the shape of a pointed arch, supported by steel frames. It stands among trees, and several are enclosed by it. Game birds, herons and other large species live in this aviary, and many smaller species, which would suffer out of doors in winter, dwell there during the summer months. See CAGE-BIRDS.

AVIATION. See AERONAUTICS, HISTORY OF.

AVIATION SICKNESS. The effect of this sickness is noticed upon the pilots of aeroplanes when flying very high, and when mounting or coming down quickly. When mounting in the air breathing becomes shorter when at 5,000 feet height, and this effect is more noticeable than with ordinary balloons. The heart is noticed to beat faster, but generally there are no palpitations, and there is only a nervous sensation, due to anxiety and the emptiness of space. Buzzing in the ears is noticed only at a greater height, about 6,000 feet. When flying at 3,500 feet, and especially above 5,000 feet, the reflex movements of the system have a greater amplitude. This appears to be due to a combination of causes, such as cold, a more rapid breathing, quicker heart-beats, the effect of sunlight and troubles of hearing, to which we must add nervous tension and fatigue. One curious effect is a great tendency to sleep, and this is so strong that the eyes sometimes close, in spite of all efforts to keep them open.

AVICENNA (ABU 'ALI AL-HUSAIN IBN ABDALLAH IBN SINA), Arabian philosopher and physician: b. Afskena, near Bokhará, 980; d. Hamadan 1037. His precocity was extraordinary, at ten he knew the Koran by rote; also much Arabic poetry. He learned the rudiments of medicine, arithmetic and geometry from wandering teachers. At seventeen he received a court appointment as physician to the amir, and had access to the library of the Samanids. The dynasty of the latter ended in 1004 and thereafter Avicenna led a very arduous life, wandering from place to place. Finally at Jorgan, near the Caspian Sea, he met with a friend, who secured him a dwelling in which he lectured on logic and astronomy. Later he was imprisoned under Taga Addaula, but escaped and fled to Ispahan, where he was welcomed by the prince. His later years were spent in the service of Abu Ya 'far 'Ala Addaula, to whom he acted as physician and literary adviser, and whom he accompanied even on his campaigns. His greatest work is the 'Canon of Medicine,' based on the Greek medical works. It was long used as a textbook both in the Orient and Occident, and is still highly prized in the former; an Arabic edition of it was published at Rome in 1593, and a Hebrew version at Naples in 1491. About 100 treatises are ascribed to Avicenna. Scarcely any science was left untouched by him. Among his medical works translated into Latin are 'Medicamenta Cordialia,' 'Canticum de Medicina' and 'Tractatus de Syrupo Acetoso.' He followed Aristotle in philosophy. In this field his 'Logic' and 'Metaphysics' have gone through several editions. Consult Brockelmann, 'Geschichte der arabischen Litteratur' (Weimar 1899); Carra de Vaux, 'Avicenne' (Vol. I, Paris 1900); Ibn Khallikan, 'Bibliographical Dictionary' (Stone trans., 1842); Wüstenfeld, 'Geschichte der arabischen Aerzte' (1840).

AVID, SIR **John**, Canadian banker: b. Longueuil, Quebec province, 15 Nov. 1855. He was educated at Toronto Model School, took up railway work before entering the banking profession; was appointed superintendent of the Central Western branches of the Canadian Bank of Commerce in 1908, assistant general manager in 1911, manager in 1915 and was knighted in 1917.

AVIGNON, a've-nyôn' (ancient *Avenio*), France, city, capital of the department Vaucluse, on the left bank of the Rhone 30 miles from the Mediterranean. It consists generally of large antique houses, in narrow, crooked, dirty streets. The principal objects of interest are the large and very ancient cathedral; the papal palace, with lofty massive walls and strong towers, and the chamber of the Inquisition. The Musée Calvet contains Roman and other antiquities and a famous picture gallery. The public library contains 140,000 printed volumes and 32,000 manuscripts. The silk manufacture is the principal source of employment at Avignon, and the rearing of silkworms is carried on extensively in the district. The city has also manufactories of velvet, woolen and other goods, hats, jewelry, etc., with silk dyeworks, paper-mills, tanneries, agricultural implements, tin, copper, hardware, chemicals and oil works, etc., and a trade in wine, brandy, iron, cotton, wool, grain and other articles, of which it is the entrepôt for Lower Dauphiné, Provence and all Languedoc. Here Petrarch lived several years; here he saw his Laura, who formed the subject of his most beautiful verses, and whose tomb is still to be found in the Franciscan Church. The fountain of Vaucluse is five leagues from Avignon. It belonged to the papal see from 1348 to 1791, and from March 1309 to September 1376 seven Popes in succession, from Clemens V to Gregory XI, were compelled to reside in this city. The Catholic historians commonly call this period the Babylonish captivity of the Popes. It is the chief centre of the Felibrige Brotherhood, organized about 70 years ago to promote the revival of the Provençal language and literature. Consult Müntz, 'La cour pontificale d'Avignon' (in *Revue des questions historiques*, Paris 1899);

O'Kay, 'Story of Avignon' (London 1911); Peujon, 'Avignon; la ville et le palais des papes' (Avignon 1905). Pop. (1911) 49,314.

AVILA, ä'vę-la, **Gil Gonzalez d'**, Spanish antiquary and biographer: b. Avila 1577; d. 1658. He was made historiographer of Castile in 1612, and of the Indies in 1641. Most valuable works: 'Teatro de las Grandezas de Madrid' (1623); and 'Teatro eclesiástico de la primitiva iglesia de las Indias Occidentales' (1655); 'Teatro eclesiástico de las ciudades é iglesias catedrales de España' (Salamanca 1618); 'Teatro eclesiástico de las iglesias de España' (2 vols., Madrid 1656).

AVILA, Juan d', celebrated Spanish preacher, commonly called the "Apostle of Andalusia": b. Almodavar del Campo 1500; d. at Montilla 1569. His missionary labors in Andalusia were prosecuted with singular success, until he arrived at the age of 50, when, with a wornout constitution, he was obliged to desist. His 'Spiritual Letters' have been translated into most European languages.

AVILA, Spain, a province bounded on the north by Valladolid, east by Segovia and Madrid, south by Toledo and Cáceres and west by Salamanca. It has an area of 2,570 square miles. Avila is naturally divided into two sections, differing completely in soil, climate, productions and social economy. The northern portion is generally level; the soil is of indifferent quality, strong and marly in a few places, but rock in all the valleys of the Sierra de Avila, and the climate has extremes of heat and cold. The population of this part is mainly agricultural. The southern division is one mass of rugged granitic sierras, interspersed with valleys abounding in rich vegetation. In this region stock-breeding is an important industry. The mountains contain silver, copper, lead, iron and coal, but their mineral wealth has been exaggerated and mining has been practically abandoned. Quarries of fine marble and jasper exist in the district of Arenas. Except Avila, the capital, there are no important towns. The principal production is the wool of the merino sheep. Olives, chestnuts and grapes are grown, and silk worms are kept. There is little trade and the manufactures are few, consisting chiefly of copper utensils, lime, soap, cloth, paper and combs. Pop. of province 200,000.

AVILA, Spain, city and capital of the province of Avila, a modern division of Old Castile. It was once one of the richest towns of Spain. A university founded here in 1482 by Ferdinand and Isabella continued its existence until the beginning of the 19th century. In 1917 it is still, architecturally, a mediæval town, preserving unaltered many of the buildings that were new in the 12th century and the splendid walls built in the last few years of the 11th. Excellent examples of Romanesque are the churches of San Vincente and San Pedro. The west porch of the former is one of the most important creations of mediæval art in all Spain. Also very noteworthy is the cathedral, exceedingly Spanish in its picturesque variety (or lack of unity), and with much interesting sculpture, from the 13th century to the Renaissance. This granite-gray city surrounded by beautiful, rugged country, recalls most vividly the great saint of Avila. Santa Teresa, who lived here many uneventful years in the 16th century before starting on her career as a reformer. At the present time the principal employment in the town is spinning. Pop. about 12,500.

AVILA Y ZUÑIGA, ä'vę-la ę thoo'nyę-gą, **Don Luis d'**, Spanish general, diplomatist and historian; a favorite of Charles V: b. 1500; d. 1564. He was in high favor with the Emperor, accompanied the latter to Africa and was his ambassador to the Popes, Paul IV and Pius IV. His 'Comentarios de la guerra de Alemaña, hecho por Cárlos V en 1546 y 1547' is a valuable if partial record of Charles' War in Germany. It has been translated into several languages.

AVILES, ä-vę-lās, **Pedro Menéndez d'**, Spanish seaman and founder of Saint Augustine, Florida: b. Avilés, Asturias, 15 Feb. 1519; d. 17 Sept. 1574. At the age of 14 he ran away to sea, and was engaged till he was 30 in a life of adventure as a corsair. In 1549 he was appointed to command the convoy which guarded ships in the American trade, and executed this commission with great efficiency. He was later engaged in transporting war supplies to the low countries during the war with France. The French Huguenots having established a colony in Florida, in territory which was claimed by Spain on the grounds of prior discovery and settlement, it was decided to remove this menace to the Gulf trade of Spain and Pedro Menendez was commissioned in 1565 to undertake the task. He reduced the French colony and hanged the French prisoners, whom he regarded as heretics. He discovered and named the bay of Saint Augustine and established on the site of the French colony another which he called San Mateo. He remained in Florida till 1567, busy with his colony. His letters prove him to have been a pious and high-minded officer, who never imagined that he could be supposed by any honest man to have gone too far in massacring the Frenchmen.

AVISON, Charles, English composer: b. Newcastle-on-Tyne 1710; d. 1770. He attained his musical training in Italy, after which he was an organist for some years. In his 'Essay on Musical Expression' (1752) he attracted some attention by comparing the French and Italian composers with the Germans, to the disadvantage of the latter. His concerts and sonatas attained great popularity in his time. Browning refers to him in his 'Parleyings with Certain People.'

AVITUS, Marcus Mæcilius, an emperor of the West. He belonged to a Gaulish family in Auvergne, and gained the favor of Constantius, the colleague of Honorius, and of Theodoric, King of the Visigoths. He served with distinction under Ætius, became prefect of Gaul, and concluded a favorable treaty with the Goths. He afterward retired into private life until the invasion of Attila, when he induced the Goths to join the Romans against the common enemy. Avitus was proclaimed emperor in 455, took for his colleague Marcianus, and died the year following.

AVITUS, Saint, bishop of Vienne in Burgundy from 490 until his death in 523. He was the leading champion of his day in the

conflict with Arianism and Semi-Pelagianism. A signal victory in a public disputation gained for him the esteem and confidence of King Gundobald, whose son Sigismund he received into the Catholic Church and who was afterward canonized as a saint. His writings have given him a prominent place in early Burgundian-Roman literature. His chief work is a didactic poem in five books, entitled 'De Spiritalis Historiæ Gestis,' and deals with such subjects as the origin of the world, original sin, etc. Another poem in praise of chastity, while inferior in literary merit to the work just mentioned, contains much of value from a historical standpoint. Consult Binding, 'Geschichte des burgundischen Königreichs' (Leipzig 1868); Frantz, P. N., 'Avitus von Vienne alo hierarch und politiker' (Greifswald 1908); Goelzer, Henri, 'La latin de Saint Avit, évêque de Vienne' (Paris 1909).

AVIZ, ä'vesh, **Order of,** a Portuguese order of knighthood, created in 1147 by Alphonso I. The knights were then called Knights of Evora, but took their present title, in 1287, from their gallant defense of the fortress of Aviz against the Moors. The order was changed from an ecclesiastical to a civil institution in 1789. Membership was given as a reward of merit for marked service to Portugal. In 1823 the order was extended to Brazil and soon became recognized as a national order there. During the empire the emperor was the grand master.

AVLONA, ạv-lō'nạ, or **VALONA,** a seaport in Albania, protected by the island of Sasseno, the ancient Saso. It carried on considerable trade with Brindisi, etc. The Christian inhabitants, chiefly Italians, are engaged in commerce, exporting oil, wool, salt, pitch, and especially come 40,000 tortoise shells yearly. The inhabitants are employed in the manufacture of arms and woolen fabrics. Valonia, a material exported to England for tanning, is the pericarp of an acorn grown nearby. Up to 1691 the town belonged to the Venetians. In 1913 it was made the seat of government of the new principality of Albania. It was taken by the Austrians in the great war which began in 1914. Pop. about 6,500.

AVOCA, Pa., borough in Luzerne County, 10 miles northeast of Wilkesbarre, on the Central of New Jersey, the Delaware and Hudson, the Lehigh Valley and the Erie railroads. It is in the centre of the mining regions and most of its inhabitants are engaged in that industry. Some silk mills are also in operation in the town. Pop. 4,634.

AVOCADO (ăv'ō-kā'dō) **PEAR,** a tropical fruit. See ALLIGATOR PEAR.

AVOCET, a shore-bird of the limicoline genus *Recurvirostra,* remarkable for its very slender beak, which curves upward toward the end like a cobbler's awl. It is a near relative of the stilt sandpiper, and various species occur throughout the world. The North American species, *Recurvirostra americana* is found in summer throughout the temperate parts of the country, migrating to the tropics in winter. It is about 17 inches in length, brownish-black above and white below, with the head, neck and chest light cinnamon. Its general habits are those of sandpipers. It is common in the Western States where it is shot as game. Consult Cones, 'Birds of the Northwest' (Washington 1874).

AVOGADRO, Amadeo, CONTE DI QUADREGNA, Italian physicist and discoverer of the rule in chemistry which bears his name: b. Turin, 9 June 1776; d. July 1856. In 1820 he was a professor of physics in his native city. He has published much matter on physics, but the one work which made him famous and in which was set forth his rule was 'Essai d'une manière de déterminer les masses relatives des molécules élémentaires des corps, et les proportions selon lesquelles elles entrent dans les combinasions' (1811).

AVOGADRO'S HYPOTHESIS. This is the hypothesis given by Avogadro in 1811 to the effect that the number of molecules in a volume v of gas at temperature t and pressure p is independent of the nature of the gas. Though it is sometimes called Avogadro's rule or Avogadro's law, it is strictly speaking neither a rule nor a law, but a hypothesis to explain the simple relation of proportionality between the densities of gases and their combining weights. Though Dalton denied the truth of this hypothesis, he saw before the work of Avogadro that it was the consequence of the generally recognized chemical facts. In the early history of this hypothesis much confusion arose for want of a sufficiently clear understanding of the relation between atoms and molecules. Certain vapors which were formerly supposed to form exceptions to Avogadro's hypothesis, such as those of ammonium chloride and phosphorus pentachloride, have been shown to be dissociated by heat into mixtures, and not to be true vapors at all.

AVOIRDUPOIS, ăv'ẽr-dū-poiz' (French *avoir du poids,* to have weight), a system of weights and measures in which a pound contains 7,000 grains or 16 ounces, while a pound troy contains 5,760 grains or 12 ounces. All larger and coarser commodities are weighed by avoirdupois weight. The avoirdupois ounce is less than the troy ounce in proportion of 72 to 79. Avoirdupois is the weight used in the United States, where generally the hundred weight contains only 100 pounds and the ton, 2,000 pounds.

AVON, ā'vŏn, the name of several rivers in England, the most important of which are the following: (1) The Upper Avon, rising in Leicestershire, runs southwest, and falls into the Severn at Tewkesbury. Stratford-on-Avon, a town on this river, is the birthplace of Shakespeare; (2) the Lower Avon, which rises near Tetbury, in Gloucestershire, and falls into the Severn northwest of Bristol, being navigable as far as Bath; (3) in Monmouthshire; (4) in Wiltshire and Hampshire, enters the English Channel at Christchurch Bay, in the latter county.

AVON, N. Y., village in Livingston County, 20 miles southwest of Rochester, on the Genesee River, and on the Erie Railroad. It has mineral springs, corn and pea canning establishments, and a bean-shipping plant. The waterworks are owned by the village. Pop. 2,053.

AVON, The. See WASP, REINDEER, AVON AND CASTILLIAN.

AVONDALE, a former suburb of Birmingham, Ala., with which it is now incorporated. It was settled in 1884 and has cotton gins and manufactories of building materials.

AVONDALE, Scotland, a parish in the county of Lanark. At the battle of Drumclog, fought near this place 1 June 1679, Grahame of Claverhouse, the famous Viscount Dundee, was defeated by the forces of the Scottish Covenant. A graphic description of this battle is found in Sir Walter Scott's 'Old Mortality.'

AVRANCHES, ą-vrānsh', France (the Roman *Abrinca*), town of La Manche department, about three miles from the Atlantic, and 30 miles east of Saint Malo. It is pleasantly situated on a hill the summit of which was crowned by a magnificent cathedral, built in the 11th century, and destroyed at the revolution in 1790. In this cathedral Henry II did penance before two of the Pope's legates for the murder of Thomas à Becket. One of its bishops was the celebrated Huet, author of the 'Demonstratio Evangelica.' The manufactures are chiefly lace, white thread and wax candles, and there is some trade in agricultural produce. Pop. 7,200.

AVULSION (Latin, *avulsio*, a tearing off), a term in law denoting the sudden transfer by natural causes of a portion of one man's land to that of another, as when the course of a river is suddenly changed and former boundaries altered. It differs from accretion, which describes a gradual addition to the property of a riparian owner by the action of the water. See ALLUVION.

AWAJI, ą-wä'ję, one of the islands of Japan, situated between the main island and Sikokee. Its area is 218 square miles. Pop. 189,000.

AWARD is the judgment or decision of arbitrators or referees, on a matter submitted to them. The award should be consonant with and follow the submission, to be binding. It must be final and certain. It must be possible to be performed, and must not direct anything illegal to be done. At common law an award could be oral or written, but in some of the States an award to be valid must be in writing. The New York Code of Civil Procedure provides that an award to be valid must be in writing.

AWATA (ą-wä'tą) **WARE,** a yellow faience called "egg-ware" by the Japanese, manufactured in the village of Awata, a suburb of Kioto, and largely purchased in the United States.

AWE, â, a narrow Scottish lake in Argyllshire, about 23 miles long, and communicating by the river Awe with Loch Etive. It is of great depth, has sloping and well-cultivated shores, terminated by ranges of lofty mountains, among which that of Ben Cruachan, rising to a height of 3,670 feet, at its northern extremity is most conspicuous. A number of islets are scattered over its surface, and on two of them are some beautiful ruins.

AXAYACAT, ä'chą-yą-kät', or **AXAYACATL,** a Mexican fly, the eggs of which, deposited abundantly on rushes and flags, are collected and sold as a species of *caviare*. The use of these as an article of diet was learned by the Spanish settlers from their predecessors, the native Indian Mexicans, who called the dish *ahuauhti*.

AXAYACATL, ä'chą-yą-kä't'l, a Mexican emperor: d. about 1477. He was the father of Montezuma, whom Cortez conquered, and reigned 14 years. He was already famous as a warrior when he became Emperor of the Aztecs, and inaugurated his reign by a successful expedition against Tehuantepec and in 1467 conquered anew the cities of Cotasta and Tochtepec. A little later he repelled the tribes who strove to get possession of the Mexican capital and maintained a vigorous warfare against his neighbors. The palace of Axayacatl, a gigantic pile of stone buildings, became a barracks of the Spaniards. His treasures were discovered by Cortez within a concealed door and the chronicler of the conquest exclaims that "it seemed as if all the riches in the world were in that room." They consisted of gold and silver in bars and in the ore, many jewels of value and numerous rich and beautiful articles of curious workmanship, as imitations of birds, insects or flowers.

AXE (apparently an original Aryan word), a long-handled tool for wood-cutting. Its essential feature is the helve, though a certain shape is imposed by the nature of its service. The chipped flint of the oldest Stone Age was a tool of all work, to crush, dig or cut (rather, bruise off), as occasion demanded, and was too heavy and shapeless to be used except by hand. As soon as one was shaped and sharpened to admit of tying a handle to it for a heavier stroke, the axe came into being and was probably the earliest implement thus differentiated. So natural a device was separately invented by each race early in its history and made of the material at hand: flint in England and America; whinstone or granite in Ireland and by the lake dwellers of the Continent; bone by the American Indians and Eskimos; while stone axes are still used by some of the South Sea Islanders. In all these cases and until the use of metal, the handle was secured with a thong, as piercing with an eye was impracticable. The first copper and bronze "celts" were made in the same way. But when casting had become familiar, it was seen that there was no difficulty in casting a hole to thrust the handle in, making a much surer and heavier stroke; and with this "eye" the modern axe appeared. The bronze axe was lightened and better shaped, and in its turn displaced by iron, for which, with the progress of invention, has been substituted an iron butt inset with a steel cutting part. The old hand forges have for some generations been replaced by immense establishments with developed machinery. The American process consists of cutting the butt from a piece of white-hot iron, punching the eye, then reheating and shaping it by pressure between concave dies; again heating, cutting in the edge a groove, into which the arched steel edge-piece is set, then welding the two and drawing out the axe to a proper edge by trip-hammers at a white heat. The next process is hammering off the implement by a combination of hand and machine work and restoring the shape lost in

drawing out. It is then ground to symmetry, hung on a revolving table in a furnace and heated over a small coal fire, at a peculiar red heat, determined by the eye; cooled in brine and then in fresh water and removed to another furnace, where it receives the last temper. It is next polished to a finish that shows every flaw and enables it to resist rust and enter wood easily; then stamped, the head painted to prevent rust, weighed, labeled and packed for sale.

AXEL, or **ABSALON,** Danish prelate, archbishop of Lund: b. near Soroë, Zealand, 1128; d. 1201. His family name was Axel. In 1157 he was chosen bishop of Roeskilde or Rothschild. In that age warlike pursuits were not deemed inconsistent with the clerical office, and Absalon was a renowned warrior by sea and land, as well as a zealous ecclesiastic, his avowed principle being that "both swords, the spiritual and the temporal, were intrusted to the clergy." To his exertions as statesman and soldier Waldemar was largely indebted for the independence and consolidation of his kingdom.

AXEL AND VALBORG, a tragedy in five acts by Oehlenschläger, was written in Paris in 1808 and printed in Copenhagen in 1810, latest English translation by F. S. Kolle. The story is taken from the best known of the Danish romantic ballads. The last verse Oehlenschläger used as a motto:

> May God forsake the wicked wretch
> Who two like these would part
> When glows a warm and mutual love
> In young and virtuous heart

The ballad was well known throughout the Scandinavian countries long before Oehlenschläger's time. In Holberg's 'Peder Paars,' the bailiff's wife was almost drowned in a flood of tears because parts of it had been read to her.

The whole action of the drama takes place in the famous Trondhjem Cathedral, in Norway, during the reign of Haakon Herdebred. Axel and Valborg are cousins who love each other. In spite of the pope's dispensation removing the legal impediment, a scheming monk prevents their marriage. In this tragedy of a Northern woman's true and constant devotion the beauty of the ballad is brought to its full fruition. In its simplicity, its pathos and tragic ending, it makes an almost overwhelming impression on the spectator. (Compare Björnson's 'The Fisher Maiden').

In his own generation Oehlenschläger's drama was the most favored and admired of all his writings. Through it, the romantic-sentimental style of poetry gained general favor. When Baggesen, beginning his review in a critical and hostile spirit, reached the famous lines spoken by the pure and innocent Valborg, as she crowns her lover's initials with flowers: "I bid thee, my love, good morning," he was absolutely carried away and praised the work in the highest terms.

GISLE BOTHNE,

AXELSEN, a powerful Danish family who flourished in the latter half of the 15th century and the members of which figured in the wars of Christian I and John IV of Denmark, and Karl Knutsen and Eric the Pomeranian, kings of Sweden. PETER AXELSEN was the head of the family. Of his nine sons, the eldest, OLAF, made himself master of Gothland; the second, IVER, retained that possession and became a corsair; the third, ERIC, was governor of Stockholm; and the fourth, AAGE, became a Danish councillor of state.

AXHOLME, an island in Lincolnshire, England, formed by the rivers Trent, Don, Idle and Vicardyke. Epworth, the home of the Wesleys, is the principal parish. Its area is 47,000 acres. The soil is exceedingly fertile.

AXIL, in botany, the angle between the upper side of a leaf and the stem or branch from which it grows. Buds usually grow out from the stem in axils of leaves and this position is naturally termed axillary. In anatomical terminology, the axilla is the armpit.

AXIM, ą-shēng', or ăx'ĭm, an important station and port on the African Gold Coast, near the mouth of the Ancobrah River, 70 miles west of Cape Coast Castle. Inland from Axim, in the basin of that river, and in the district between it and the Prah, gold-mining operations have been carried on on a large scale. It was built by the Portuguese, and its harbor is the best on the Gold Coast. The town is picturesque, and is an important point because of large exports of mahogany. In 1642 it was taken by the Dutch, who in 1872 ceded it, with the whole of their possessions in Guinea, to the English. Pop. 2,189.

AXINITE (Greek, "like an axe"), a mineral usually occurring in broad, acute-edged triclinic crystals, suggestive, in shape, of an axe. It has a glassy lustre, brown or yellow in color, and is translucent and strongly pleochroic. It has a hardness of 6.5 to 7, and a specific gravity of about 3.28. Its exact composition is still doubtful, but it may be described as a calcium and aluminum borosilicate, containing also varying amounts of manganese and iron. Its most important deposits are in Dauphiné, France, Mount Skopi, Switzerland, in Japan and in the United States near Bethlehem, Pa., and at Franklin Furnace, N. J.

AXIN'OMAN'CY, a mode of divination much practised by the ancient Greeks, particularly with the view of discovering the perpetrators of great crimes. An axe poised upon a stake was supposed to move so as to indicate the guilty person; or the names of suspected persons being pronounced, the motion of the axe at a particular name was accepted as a sign of guilt. Another method of axinomancy was by watching the movements of an agate placed upon a red-hot axe.

AXIOM (an assumption), a universal proposition, which the understanding must perceive to be true as soon as it perceives the meaning of the words, though it cannot be proved. It is, therefore, called a self-evident truth. In mathematics, axioms are those propositions which are assumed without proof, as being in themselves independent of proof, and which are made the basis of all the subsequent reasoning. Euclid has assumed 15 axioms as the basis of geometry. Among these are: "The whole is greater than its part"; "Things that are equal to the same thing are equal to one another"; "Magnitudes which coincide, that is, which exactly fill the same space, are equal to

one another in every respect." Bacon calls axiom a general principle, obtained by experiment and observation, from which we may safely proceed to reason in all other instances; and Newton gives the name of axiom to the laws of motion, which, of course, are ascertained by the investigation of nature; he also terms axioms those general experimental truths or facts which form the groundwork of the science of optics.

AXIS (in crystallography). See CRYSTAL.

AXIS (Latin, of unknown origin), a white-spotted deer (*Axis axis*) of India and the East Indies, known locally among the Hindus as "chitra," among the English as the "hog-deer." It resembles the European fallow deer in size and color, and as it is easily domesticated, is a favorite in European parks. The slender, sharp-pointed horns are not palmated and only a little branched, while the female is hornless. It is timid and usually goes in small herds, in which females largely predominate. It lives in thick jungles near water, and usually feeds in the night. Colored plates, illustrating its varieties, are given in Lydekker's 'Deer of All Lands' (1898).

AXMINSTER, England, market town of Devonshire, 24 miles east of Exeter, on the side of a hill above the river Axe. The parish church, a very ancient edifice, contains some interesting antique monuments. Axminster was formerly celebrated for its woolen cloth and carpet manufactures, and gave name to a special make of carpet having a thick, soft pile, now made in Salisbury. Brushes are made here, and there are flour and other mills. Pop. 3,000.

AXOLOTL, ăx'ō-lōtl (Mex., "play in the water"), a larval salamander regarded as edible. They are numerous in the lakes about the City of Mexico, are six to 10 inches long, and are prepared by either roasting or boiling and eaten with vinegar or cayenne pepper. The most extraordinary thing about them, however, is the fact that they are the young of a species of terrestrial salamander (*Amblystoma tigrinum*), well known all over the warmer parts of the United States and Mexico, which in these lakes never transform into adults, but remain permanently in the larval condition, yet become sexually mature when about six months old, so that they are able to breed. This astonishing fact was long unknown. The axolotl has bushy, external gills similar to those which permanently characterize the mud-puppy. It was regarded as a distinct animal, and named *Siredon lichenoides*. The discovery of the truth was made accidentally in Paris in 1865, when some axolotls in an aquarium in the Jardin des Plantes lost their gills and were transformed into perfected amblystomas. A lady, studying in the University of Freiburg, Frl. Marie von Chauvin, then undertook a series of careful experiments with other captives, and worked out the complete history of metamorphosis, which is dependent (at least in Europe) on a very narrow set of favorable circumstances, but differs in no essential degree from that of other salamanders (q.v.). Why the change never takes place in the Mexican lakes is unexplained. The theories in regard to it, and the detailed history of the observations above mentioned, are given by Gadow in 'Amphibia and Reptiles' (1901), with many references to other books and periodicals.

AXON, that part of the nerve cell that carries the nervous impulses, the axis cylinder process or the nerve fibre proper. See NERVE CELL; NERVE FIBRE.

AXUM, ąx-oom', a town in Abyssinia, capital of the province of Tigré, once the capital of a powerful Ethiopian kingdom, and at one time the great depot of the ivory trade in the Red Sea. The importance of this city and its kings was first made known to us by a stone (*Axumitic marble*) with a Greek inscription, first explained by Salt, who discovered it, and afterward by Buttmann and Niebuhr. The interest in this inscription was increased by the explanation which it afforded of the second half of the Adulian marble. Axum, the place where it was found, still exhibits many remains of its former greatness. Among its ruins are shown the royal throne, and groups of obelisks, originally 55 in number, one of which Salt declared to be the most beautiful that he had seen. Pop. 5,000. Consult Bent, 'The Sacred City of the Ethiopians' (1893); Glaser, 'Die Abessinier in Arabien und Afrika' (Munich 1895); Mommsen, T., 'Provinces of the Roman Empire' (New York 1886).

AYACUCHO, ä'yą-koo'chō, Peru, the name of a department and also of the departmental capital. The department has an area of about 18,185 square miles, and it is traversed by both chains of the Cordilleras and watered by numerous rivers. It produces cereals, maize, potatoes and a little coffee, sugar, cotton, etc. Cattle and hardy sheep are bred extensively. The provinces are: Lucanas (rich in silver), Ayacucho, Cangallo, Huanta, La Mar and Parinacochas. The capital, situated on the main road from Lima to Cuzco, has a cathedral and about 20 churches. It was founded by Pizarro in 1539, and long known as Huamanga. A battle that took place here was one of the most celebrated in the history of South America, having been decisive of the independence of upper and lower Peru. (See AYACUCHO, BATTLE OF.) Pop. of town 22,000; of the department, in 1916, about 227,000.

AYACUCHO, The Battle of, a decisive engagement in the South American struggle for liberty; was fought on 9 Dec. 1824, at and near the Peruvian town of that name. On the one side was the Spanish viceroy of Peru with nearly all that remained of the Spanish power in its last stronghold upon the continent; on the other General Sucre, second in command to Bolivar (the latter not being present), with Colombian troops, and Peruvians led by General Lamar. The viceroy was taken prisoner; the utter defeat of his army made possible the independence of Bolivia (realized the following year), and strengthened the republican governments in all the neighboring states.

AYALA, ą-yä'lą, **Adelardo Lopez de**, Spanish dramatist: b. Gaudalcanal, Badajoz, March 1820; d. 30 Dec. 1879. After studying law in Seville, he went to Madrid, where he devoted himself entirely to poetry and speedily won national fame. His first drama, 'A Statesman' (1851), met with immediate success, and

was followed in the same year by 'The Two Noblemen' and 'Penalty and Pardon.' To the modern comedy of manners, his specific domain, he first contributed 'The Glass Roof,' and in 1861 attained to wide reputation with 'Percentage.' Of his other works the most noteworthy are 'The Modern Don Juan' (1863); and 'Consuelo' (1878), a drama.

AYALA, Lopez de, Spanish historian and poet: b. 1332; d. 1407. He was a prominent statesman and warrior during the reigns of the Castilian kings Pedro the Cruel, Henry II, John I and Henry III, and is known as the author of a 'Chronicle of the Kings of Castille' (his contemporaries), in which the crimes of Pedro the Cruel are detailed and drawn in colors said to be sometimes overcharged.

AYAMONTE, ä'yą-mōn'tā, Spain, seaport town, near the mouth of the Guadiana, which here forms the boundary between Spain and Portugal. It is picturesquely situated on the slope and at the foot of a hill. The upper part of the town consists of narrow and irregular streets; those of the lower part are regular and wide. There are three public squares. The principal occupation of the inhabitants is fishing, shipbuilding and coast trading. Pop. (1910) 9,471.

AYE-AYE, äĭ'äĭ' (native Malagasy name; from its cry), a lemur (*Daubentonia madagascarensis*), about the size of a rabbit, and with teeth like a bat. It is small and brownish, with a long bushy tail. Arboreal and nocturnal in habits, it lives in bamboo jungles, feeding on vegetables and the larvæ of certain borers. Its feet, as well as its hands, have opposable thumbs, and exceedingly long, naked, flexible fingers armed with pointed nails, suitable for extracting grubs out of deep crevices. Consult Baron, 'Proceedings Zoological Society' (London 1882); Lydekker, 'Mostly Mammals' (London 1903); Ingersoll, E., 'Life of Mammals' (New York 1906).

AYESHA, ą-yĕ'shä, the daughter of Abu-Bekr and favorite wife of Mohammed: b. 610 or 611; d. 677 or 678. After Mohammed's death she opposed the succession of Ali, raised an army against him, and was taken prisoner, but dismissed with that spirit of chivalry which had already arisen among the Arabians.

AYLESBURY, ālz'bĕr-ĭ, England, market town in Buckinghamshire, 38 miles northwest of London, in the centre of the fertile valley of Aylesbury. There are many old houses, irregularly but picturesquely built. The parish church of Saint Mary's is a fine early English edifice, and there are various other places of worship; a county-hall, market-house, clock tower and corn exchange. There are also baths, a large county hospital, and the only convict prison for women in England. The chief industries are printing, making condensed milk and poultry-raising for the London market, Aylesbury ducks being widely known, and there are several breweries and flour-mille. Aylesbury is very ancient, having been taken from the Britons by the Saxons in 571. Pop. (1911) 11,048.

AYLESFORD, ālz'fĕrd, England, town in Kent, three miles from Maidstone, and 39 miles southeast of London. Remarkable ancient remains occur here, comprising an extensive cromlech, or burying place, known as Kit's Coity, and, in the neighboring chalk hills, large circular sepulchral pits. Pop. (1911) 2,569.

AYLESWORTH, Sir Allen Bristol, Canadian statesman: b. Newburgh, Ontario, 27 Nov. 1854. He graduated at Toronto University in 1874, became a barrister in 1878, and K.C. in 1889. He was returned as a Liberal to the Dominion House of Commons in 1905, occupying the portfolio of postmaster-general in Laurier's cabinet, 1905–06, and minister of justice 1906–11, when he retired from political life. A member of the Alaskan Boundary Commission in 1903, he dissented from and refused to sign the award, which he subjected to a searching criticism. He was British agent before The Hague Tribunal in the fisheries reference of 1910, and was created K.C.M.G. in 1911.

AYLLON, ī-lyōn, **Lucas Vasquez de,** Spanish adventurer: b. about 1475; d. 1526, who, in 1509, occupied the position of consul at the Supreme Court of Saint Domingo, and was subsequently employed by Fernando Cortes on a mission to Velasquez. In 1520, he joined an expedition to Florida, treacherously captured a great number of natives, and proposed to found a new colony, but was unsuccessful, and is supposed to have lost his life while engaged in a second expedition to Florida.

AYLMER, two lakes in Canada: one, north of Great Slave Lake, is about 50 miles in length and half as wide, the other lies about 70 miles south of Quebec, in Wolfe County, at the headwaters of the Saint Francis River.

AYLMER, āl'mėr, **John,** English prelate: b. Norfolk 1521; d. 1594. He was tutor to Lady Jane Grey. On the accession of Mary, he was forced to leave his country, but when Queen Elizabeth came to the throne he returned to England; and in 1576 was made bishop of London. He wrote a powerful reply to the 'Monstrous Regiment of Women' by John Knox.

AYLMER, Matthew Whitworth, 5th Baron: b. 1775; d. 1850. He entered the army in 1787, serving in the West Indies, in Holland, and in the Peninsula under the Duke of Wellington. He was governor-in-chief of Canada, 1830–35.

AYLOFFE, ā'lŏf, **Sir Joseph,** an English antiquary: b. about 1709; d. 1781. He was one of the first council of the Society of Antiquaries, a commissioner for the preservation of state papers, and author and editor of several works, of which the best known is his 'Calendars of the Ancient Charters,' etc.

AYMARAS, ī'mą-räz', an Indian race of Bolivia and Peru, speaking a language akin to the Quichua. They are physically characterized by great chest development, caused by the rarefied air of the region they inhabit.

AYMON, ā'mŏn, the surname of four brothers, called respectively Alard, Richard, Guiscard and Renaud, sons of Aymon or Haimon, Count of Dordogne, who figure among the most illustrious heroes of the chivalric poetry of the Middle Ages; their historic existence was considered problematical until M. Longnon in 1879 established the fact that the Aymons lived in the first half of the 8th century. Their career furnished rich material to the romantic narratives of the age of Charles

Martel. A novel, entitled 'The Four Aymon Brothers,' by Huon de Villeneuve, a French poet of the 13th century, details very minutely their exploits, and Ariosto conferred a poetical immortality on the family by the publication of his 'Roland,' in which Renaud, the bravest of the four brothers, plays continually the most distinguished part.

AYOUBITES, or **AYYUBITES,** the Saracenic dynasty founded by Saladin, which in Egypt supplanted the Fatimite caliphs, about 1171 A.D. Several of the descendants of Saladin, known as Ayoubites, afterward ruled in Egypt, Syria, Armenia and Arabia Felix. In the 13th century their power was destroyed by the Mamelukes.

AYR, ār, Scotland, town on the river Ayr, 34 miles southwest of Glasgow. The principal streets of modern Ayr are spacious and well paved, and many of the buildings handsome. The most important edifices are several churches of various denominations; the town-hall and connected offices, in great part completed in 1881, surmounted by a fine spire of older date, 226 feet high; the county buildings; the academy, a celebrated educational institute, the buildings of which are handsome and commodious; the Wallace tower, 115 feet high on the site of a more ancient tower; the free library; the railway station and hotel; a hospital, etc. There is a handsome esplanade along the sea front 1,500 yards long. Two bridges connect Ayr with Newton and Wallacetown, incorporated in the burgh. One of these, opened in 1879, occupies the place of the «New Brig» of Burns' 'Brigs of Ayr,' the «Auld Brig» (built 1252) being still serviceable for foot traffic. There is now also a third bridge farther up the river, besides the railway bridge. Ayr exports manufactured goods, iron, coal, whetstones, etc.; and imports iron-ore, grain, timber, slates, bricks, etc. The harbor lies within the mouth of the river, and is enclosed and protected by a north and a south pier and a breakwater; there being also a wet dock and a slip dock. Shipbuilding is carried on, also tanning, boot and shoe making, the manufacture of carpets, lace curtains, etc. The poet Burns was born in a house which stands within one and one-half miles of the town, between it and the church of Alloway («Alloway's auld haunted kirk»), and a monument erected to his memory stands on a height between the church and the bridge over the Doon. Pop. 33,000.

AYR, a river of Ayrshire, Scotland, which after a course westward of 18 miles, finally loses itself in the Firth of Clyde below the town of Ayr.

AYRER, ī'rėr, **Jacob,** German dramatist: b. Nuremberg about 1560; d. there, 26 March 1605. Between 1595 and 1605 he wrote more than 100 plays, of which the 'Opus Theatricum' (Nuremberg 1618) contains 30 tragedies and comedies, and 36 Shrovetide plays and vaudevilles. In his dramas the influence of the English stage is apparent.

AYRES, ārz, **Alfred.** See OSMUN, THOMAS ERMBLEY.

AYRES, Anne, American author: b. England 1816; d. February 1896. She was the first member of an American sisterhood in the Protestant Episcopal Church. She wrote 'Evangelical Sisterhood' (1867); and 'Life of Augustus Muhlenberg.'

AYRES, Brown, American educator: b. Memphis, Tenn., 25 May 1856. His earlier education was attained in private schools, after which he studied engineering, graduating from Stevens Institute of Technology. In 1880 he was appointed professor of physics at Tulane University, where he remained for 24 years, acting at times as dean of the College of Technology and president pro tempore. In 1904 he became president of the University of Tennessee. In 1910 he was president of the National Association of State Universities.

AYRES, Leonard Porter, American educator: b. Niantic, Conn., 15 Sept. 1879. He studied at Harvard and Columbia Universities, then, in 1902, went to Porto Rico as one of the first American teachers. Here he became, first, superintendent of schools in the districts of Caguas and San Juan, then general superintendent of all the schools in Porto Rico. In 1908 he became connected with the work of the Sage Foundation, becoming chairman of the committee in charge of the problem of backward children. He is the author of 'A Course of Study for the Schools of San Juan' (1905); 'Medical Inspection of Schools' (with Luther H. Gulick, 1908); 'Laggards in Our Schools' (1909–13); 'Open Air Schools' (1910); 'Seven Great Foundations' (1911); 'The Public Schools of Springfield, Ill.' (1914); 'The Measurement of Spelling Ability' (1915); 'School Building and Equipment' (1915); 'Summary of the School Survey of Cleveland, Ohio' (1916).

AYRES, Romeyn Beck, American soldier: b. East Creek, Montgomery County, N. Y., 20 Dec. 1825; d. 1888. Graduating from West Point in 1847, he entered the artillery arm of the service in time to participate in the Mexican War. When the Civil War broke out he was a captain and as such took part in the first battle of Bull Run. From October 1861 to November 1862 he was chief of artillery under Gen. W. F. Smith. He was with the army of the Potomac in the Peninsular campaign; afterward he saw fighting in the battles of South Mountain, Antietam, Fredericksburg, Chancellorsville and Gettysburg, being a division commander in this last engagement. In August 1863 he was ordered to New York with command to assist in the suppression of the draft riots. At the end of the war he was breveted brigadier-general and major-general in the regular service, serving as lieutenant-colonel and colonel in the regular establishment until his death.

AYRSHIRE, Scotland, an extensive maritime county about 60 miles in length, with a breadth varying from 10 to 26 miles. Its coast line is about 75 miles in length, has several excellent harbors. The singular rock off the coast, known by the name of Ailsa Craig, belongs to the county, as also do one or two other islets. The surface has no great elevations, the highest summits varying from about 1,200 to 1,900 feet. The principal streams are the Ayr, Stinchar, Girvan, Doon, Irvine and Garnock. The mineral riches are very considerable. Coal is abundant, especially in the middle and north-

ern parts of the county, and there are over 100 collieries. Extensive seams also of blackband ironstone exist, and are now being actively worked, Ayrshire having become the great seat of the iron manufactures of Scotland next to Lanarkshire. Graphite is found in some localities; and lead, antimony and copper. Limestone and freestone abound. Millstones, of coarse granite, much esteemed for their hardness and durability, are quarried near the north coast, in the district of Cunningham. The native sheep are bred in great numbers; their wool is coarse and scanty, but the flesh is excellent. The horses of Ayrshire are of superior breed, being hardy, strong and of large size. The woolen manufactures are extensive, particularly carpets, bonnets and worsted shawls, which are produced in great quantities. There are valuable fisheries and ship yards on the coast. On the coast is the ancient castle of Turnberry, in which Robert Bruce, King of Scotland, is said to have been born, and where he is known to have spent many of his youthful years. It was here that a fire, accidentally kindled, was mistaken by Bruce for an appointed signal, and caused him to cross the sea from the island of Arran opposite to attempt the deliverance of his country. Of the ecclesiastical ruins the most interesting is the abbey of Crossragruel, founded in 1244. The chief towns are Ayr, Kilmarnock, Irvine, Stevenston, Dundonald, Troon, Saltcoats, Largs and Ardrossan. Pop. (1911) 268,337. Consult Paterson, 'History of Ayrshire' (1866).

AYRTON, ār-tŏn, **William Edward,** English electrician and inventor: b. London 1847; died 1908. He entered the Indian telegraph service, having studied electrical engineering with Prof. William Thomson; became electrical superintendent and introduced throughout India the system of determining the position of a fault by electrically testing one end of a line. In 1873–79 he was professor of natural philosophy and telegraphy at the Imperial College of Engineering in Japan; in 1879 became professor of applied physics in London Technical College, and, in 1884, chief professor of physics at the Central Institute, South Kensington. He was elected president of the Institute of Electrical Engineering in 1892. With Professor Perry, he invented the ammeter, voltmeter, electric power meter, ohmmeter and dispersion-photometer; and, with Professors Jenkins and Perry, the system of telpherage. He was a voluminous writer and widely known for his 'Practical Electricity' (new ed. 1911).

AYSCUE, ās'kū, **Sir George,** English admiral who lived during the 17th century and died in 1671. He was knighted by Charles I and attained his first command in 1646. During the English Civil War the navy had largely maintained an attitude of neutrality, but in 1648 the greater part of the British fleet sailed for Holland. Those ships that remained and supported the Parliamentary cause did so largely through the persuasions of Ayscue, for which Parliament appointed him admiral. He then sailed to Barbadoes, and after a hard battle captured it from the loyalist governor. Later followed some severe naval engagements with the Dutch fleets under Tromp and Ruyter. In 1666 Ayscue's flagship was beached during an engagement and the admiral himself was taken prisoner and brought to Holland. The following year he was allowed to return to England.

AYTOUN, ā'toon, **Sir Robert,** Scottish poet: b. 1570; d. London, February 1638, and studied at Saint Andrews. Of Norman descent, his family name was De Vescy; one of his ancestors received from King Robert Bruce the lands of Aytoun, in Berwickshire, and changed his name to that of the estate. Sir Robert addressed an elegant panegyric in Latin verse to King James on his accession to the crown of England, which had, no doubt, some influence in securing to the author the favor of that monarch. He was at a later period of his life honored with the appointment of secretary to Henrietta Maria, Queen of Charles I. During his residence abroad, as well as at the court of England, he lived in intimacy with, and secured the esteem of, the most eminent persons of his time. The poems of Sir Robert Aytoun, for the first time published together in the Miscellany of the Bannatyne Club, are few in number, but are distinguished by some elegance of diction, though he never claimed to be a poet. Several of his Latin poems are preserved in the work called 'Delitiæ Poetarum Scotorum.' Dr. C. Rogers, whose first edition of Aytoun's poems appeared in 1844, without any authority included 'Auld Lang Syne' and Raleigh's 'Sweet Empress.'

AYTOUN, William Edmondstoune, a descendant of the foregoing, Scottish poet and prose writer: b. Edinburgh 1813; d. Blackhills, Elgin, 4 Aug. 1865. He studied at the University of Edinburgh and passed as advocate in 1840. His first independent work was the 'Life and Times of Richard I' (1840). In 1848 he published a collection of ballads entitled 'Lays of the Scottish Cavaliers,' which has continued to be the most popular of all his works, and has passed through numerous editions. It was followed in 1854 by 'Firmilian, a Spasmodic Tragedy'; in 1856 by the poem of 'Bothwell'; and in subsequent years by the novel called 'Norman Sinclair,' and various other original works. In 1858 he issued a critical and annotated edition of the 'Ballads of Scotland.' The translation of the poems and ballads of Goethe which he undertook in conjunction with Theodore Martin was less successful than some of his other works. In 1845 he was appointed professor of rhetoric and English literature in the University of Edinburgh — a position which he held till his death. In 1854 he became editor of *Blackwood's Magazine.* His biography was written by Sir Theodore Martin, 1867.

AYUB KHAN, ī-yoob'kän, an Afghan prince, youngest son of Shere Ali: b. about 1855. After the abdication of his brother Yakub he declared himself openly against the English. On 27 July 1880 he met General Burrows at Kushk-i-Nakhud and severely defeated him, then laid siege to Kandahar. On 1 September General Roberts, who had hurried up from Kabul by forced marches, attacked Ayub's forces and scattered them, Ayub and what was left of his army falling back on Herat. The following year he succeeded in taking Kandahar, but the new Ameer, Abd-ur-Rahman, was finally able to overcome him. For a while he was an exile in Persia. In 1887 he organized a

conspiracy to capture Herat, which failed. He finally gave himself up to the British who sent him, a state prisoner, to the Punjab.

AYUNTAMIENTO, ą-yoon'ĭą-myān'tō, the name given in Spain to municipal councils. Firmly established during the struggles with the Moors, the ayuntamientos acquired great influence and political power, the nobility being admitted to them without their class privileges. The Cortes, in 1812, adopted the leading features of the former system. On the return of Ferdinand VII, the ayuntamientos were abolished, but restored in 1837. The ayuntamientos were empowered to make up the lists of electors and jurors, to organize the national guards, to command the police within their own bounds, to direct the appointment and raising of taxes and to manage the funds of the commune. The municipal law of 1870 deprived them of all political authority, and regulated them as administrative bodies, subject in certain respects to the authorities of the provinces, the law courts and the Cortes.

AZAIS, ā'za-ĭs, **Pierre Hyacinthe,** French philosopher: b. Sorèze 1766; d. Paris 1845. He spent his early years as a teacher and a village organist. At the outbreak of the Revolution be viewed it with favor, but was soon disgusted at the violence of its methods. A critical pamphlet drew upon him the hatred of the revolutionists, and it was not until 1806 that he was able to settle in Paris. In 1809 he published his great work 'Des Compensations dans les destinées humaines,' which pleased Napoleon so much that he made its author professor at Saint Cyr. In 1811 he became inspector of the public library at Avignon, and from 1812 to 1815 he held the same position at Nancy. The Restoration government at first suspected him as a Bonapartist, but at length granted him a pension. From that time he occupied himself in lecturing and in the publication of philosophical works. In the 'Compensations' he sought to prove that, on the whole, happiness and misery are equally balanced, and therefore that men should accept the government which is given them rather than risk the horrors of revolution. His other works are 'Système universel' (1812); 'Du Sort de l'homme' (1820) 'De la phrénologie, du magnétisme, et de la folie' (1843).

AZALEA, a genus of about 25 species of shrubs of the family *Ericaceæ,* natives of the northern hemisphere, principally of eastern Asia and North America. By some botanists the genus is united with *Rhododendron* (q.v.), as may be seen below. The species have deciduous leaves and showy, often fragrant flowers, usually in terminal umbellike clusters. They are commonly divided into two groups: the Indian azaleas and the hardy deciduous azaleas, including the Ghent hybrid forms. The Indian azaleas, mostly imported from Holland and forced in greenhouses, are propagated by grafts or cuttings, rarely by seeds. They are planted in loose, moderately fertile soil; sheltered from the sun and watered freely during the summer; repotted in early autumn; and, by special attention, brought into flower as desired from late autumn until early summer. The leading species of the group is *A. indica,* of which two varieties, *amœna* and *kœmsferi* are fairly hardy as far north as New Jersey. The members of the hardy group need some protection in the north and in exposed situations to prevent injury to the flower-buds due to sudden variations of temperature. Named horticultural varieties are usually propagated by grafts or by cuttings. Seedlings are often grown for their own merits, but are generally used for stocks upon which to graft choicer varieties. The following are among the best known species of this group: *A. nudiflora,* pinxterflower, found from Canada to the Gulf of Mexico, has pink, white or sometimes purple flowers in mid-spring; *A. calendulacea,* found from New York to Georgia, has large orange- or flame-colored, particularly handsome blossoms in late spring; *A. occidentalis,* a California species, bears fragrant, white, pinkish flowers in early summer; *A. arborescens,* found in the Alleghany Mountains, has fragrant white or pink flowers in June; *A. viscosa,* clammy azalea or white swamp honeysuckle, is found in swamps from maritime Canada to Florida and westward to Arkansas, and bears fragrant white or pink flowers in June or July. Among the Asiatic members of this group the best known are probably: *A. mollis, A. rhombica* and *A. pontica.* Consult Halliday, 'Treatise on the Propagation and Cultivation of Azalea Indica'; Van Geert, 'Iconographie des Azalées.'

AZAMGARH, Ĭndia, a city and district in the Gorakhpur division of the United Provinces. The city is situated on the river Tons, and has a railway station, and a population of about 19,000. The district has an area of 2,207 square miles. The slope of the land is from northwest to southeast. The soil is fertile, and very highly cultivated, bearing magnificent crops of rice, sugar-cane and indigo. There are several indigo factories. In 1857 it became a centre of mutiny, and the scene of fighting between the Gurkhas and the rebels, and was not finally cleared until October 1858 by Colonel Kelly. Pop. 1,500,000.

AZAN' (Arabic for "announcement"), the call or summons to public prayers proclaimed by the muezzin (crier) from the mosque twice daily in all Mohammedan countries.

AZANCHEV'SKY, Michael von, Russian composer: b. Moscow 1839; d. 24 Jan. 1881. His first musical training was attained at Leipzig, under Richter and Hauptmann. In 1870 he became director of the Conservatory at Petrograd, which position he held for six years. Among his many works the most notable are a 'Fest Polonaise,' for two pianofortes; a concert overture and a sonata in B Minor.

AZARA, ąthä'rą, **José Nicholás de,** Spanish diplomat: b. Barbuñales, Aragon, 1731; d. Paris, 26 Jan. 1804. After graduating from Salamanca he was appointed, first resident, then envoy for Spain at the Vatican. Here he attained a very powerful influence, which he used against the Jesuits, until they were suppressed in 1773, and in working for the election of Pope Pius VI. It was in Rome that he acquired a deep enthusiasm for art, in which he was one of the best connoisseurs, Consult Paul Besques' 'La première ambassade de Don José Nicolas de Azara à Paris' (in *Bulletin hispanique,* Vol. III, 1901).

AZARIAH, the name of various personages mentioned in the Bible, no less than 24 of them being referred to. (1) The son of Oded, a prophet (2 Chron. xv, 1–8). (2) Azariah, also called Abednego, one of three who were thrown into a fiery furnace (Dan. i, 11). (3) One referred to by the Assyrian King Tiglath-pileser IV in an inscription, who was long believed to be the same King of Judah known as Uzziah. At least four high priests are referred to by this name.

AZARIAS, Brother (PATRICK FRANCIS MULLANY), b. 29 June 1847, near Killenaule, Tipperary, Ireland; d. 20 Aug. 1893, Plattsburgh, N. Y. (Cliff Haven). His father emigrated to the United States in 1851, leaving Patrick, his eldest son, in Ireland a few years on account of his health. At Deerfield, N. Y., near Utica, he attended the public school and later the Christian Brothers' Academy in Utica. At 14 he decided to become a Brother, and on 29 June 1862, Patrick Mullany received the black habit and white collar of a Christian Brother, and henceforth became known to the world as Brother Azarias. At 17 he was put in charge of a large class; and at 19 he was professor of mathematics in Rock Hill College, near Baltimore, Md. Ten years later he was made head of the college. His first book, 'An Essay Contributing to a Philosophy of Literature' (1874), won him the respect of scholars. His philosophical articles on literature, published in various magazines, were well received, and he was soon in demand as a lecturer before educational bodies, Catholic and non-Catholic. When in the 80's he went to Europe, he found friends everywhere; scholars who had read his books, men like Cardinal Newman greeted him as a friend. He was a promoter of the Catholic Summer School of America and of several other educational movements. After finishing his course of lectures at the Catholic Summer School at Cliff Haven, 1893, he was too ill to go home or to any of the other meetings where he was expected. His last days were spent in «Blue Point Hotel,» near the Summer School grounds. His published works are 'Aristotle and the Christian Church'; 'Books and Reading'; 'Culture of Spiritual Sense'; 'Development of English Literature'; 'Development of Old English Thought'; 'Essays Educational'; 'Essays Miscellaneous'; 'Essays Philosophical'; 'Mary, Queen of May'; 'Mary, Queen of May and Essays'; 'Phases of Thought and Criticism'; 'Philosophy of Literature'; 'Psychological Aspects of Education.'

AZAZEL, ăz'a-zĕl, the chief of the angels who married human beings and begat of them wicked men (Lev. xvi, 8, 10, 26). It is also a name which occurs in connection with the services on the Day of the Atonement, in which the high priest had all the sins of Israel confessed over the head of a goat and then had it cast over a cliff, a rite which is supposed to have been the survival of an old demon worship, which was modified by the Jews.

AZEGLIO, ad-zā'lyō, Massimo Taparelli, Marquis d', Italian author, artist, diplomatist and statesman: b. Turin, 15 Oct. 1798; d. 16 Jan. 1866. In 1816 he accompanied his father to Rome, and there occupied his time principally with painting and music. He was already favorably known as a painter, when, in 1830, he went to Milan, married the daughter of Manzoni, the great novelist, and wrote several romances. The earliest of these, 'Ettore Fieramosca,' was received with great enthusiasm. His next romance, 'Niccolò de Lapi,' became equally popular, and is esteemed by Italian critics the best historical novel in any language. Deeply imbued with the spirit of Italian nationality, in 1842 Azeglio made a tour through the provinces of Italy, awakening the revolutionary spirit which troubled the last years of Gregory XVI. After the Revolution of 1848 he supported the cause of the King of Piedmont, and, at the head of the Papal troops, fought against the Austrians at Vicenza, where he was wounded. In 1849 Victor Emmanuel appointed him president of the cabinet of ministers, an office which he resigned in 1852 to his political adversary, Count Cavour. In 1859, after the peace of Villafranca, he undertook a confidential mission as Ambassador extraordinary to England; and was afterward appointed governor of the city of Milan. For biographies see Boccardo, 'Nuova Encyclopedia Italiana'; Camerini (Turin 1861); Morozzo (Florence 1884).

AZERBAIJAN, ā'zĕr-bī-jān', Persia, the northwestern and most important province of Persia. It is bounded on the north by the Aras, on the east by the Caspian Sea, Gilan and Khamseh, on the south by Kurdistan, and west by Asiatic Turkey. Its area is 32,000 square miles. The land is very fertile, the orchards and gardens yield delicious fruits of almost every description, and great quantities, dried, are exported to Russia. Provisions are cheap and abundant, but there is a lack of forests and timber trees. Lead, copper, sulphur, orpiment, also lignite, are found; also a kind of variegated translucent marble known as Tabriz marble. The climate is healthy, not hot in summer, and cold in winter. The revenue amounts to about $1,000,000 annually. The province is divided into a number of administrative districts, each with a hakim, governor, under the governor-general, who is a responsible minister appointed by the Shah. Pop. about 2,000,000, comprising various races, as Persians proper, Turks, Kurds, Syrians, Armenians.

AZEVEDO, ä-zą-vā'dō, **Manoel Antonio Alvares de,** Brazilian poet: b. Sao Paulo, 12 Sept. 1831; d. 25 April 1852. He studied law in his native town and practised there. His 'Obras,' or collected works, were published the year after his death, a more complete collection, 'Obras completas,' appearing 10 years later (1863). The fifth edition of one volume of poems published in his lifetime appeared in 1884, under the title 'Lyra dos vinte annos.' He also wrote some minor prose works; the dramatic sketches «Bohemios»; «Marcario»; «Noite na taverna.»

AZEVEDO E CASTRO, João Paulino D', Roman Catholic missionary bishop: b. Lages, Island of Pico, Azores, 4 Feb. 1852. He was educated at the National Lyceum, Horta, Azores, and at the Seminary and University of Coimbra, Portugal. He was ordained priest in 1879, was successively professor of philosophy, theology, Church history, canon law (1879–1902)

and rector 1888–1902 of the Angra Seminary, Azores. He also served as episcopal deputy to Portugal and held various other diocesan appointments. In 1902 he became bishop of Macao, China. From 1902 to 1910 he was one of the chancellors of the Privy Council of the King of Portugal. As bishop he has built numerous churches and schools and has introduced new religious orders into his diocese and founded a college for girls at Malacca. As member of the government council he defeated the scheme for the granting of a gambling monopoly designed to make Macao the Monte Carlo of the Far East. He visited Europe in 1907 to arrange with the Pope and the French and Portuguese governments matters connected with the change of ecclesiastical jurisdiction in Hainan and Shin Hing.

AZEVEDO Y ZUÑIGA, Gaspard de, Count of Monterey, Spanish colonial governor: b. 1540; d. 1606. He was viceroy of Mexico and Peru from 1595 to 1603, during which period he explored the Pacific coast of North America and founded Monterey, on Monterey Bay, California. Many Spanish-Californian families claim to be his descendants. Many of the land claims which caused so much litigation after the American occupation were based on his grants.

AZIMUTH, in astronomy, the arc of the horizon comprehended between the meridian of the observer and the vertical circle passing through the star. It is easterly if the star is observed before, westerly if after, and zero if at the time of culmination. It is usual to connect with the quadrant a graduated, horizontal circle, called the *azimuth circle.*

AZIO, Greece, a village on the Gulf of Arta, in the district and promontory of the same name. A German archæologist, Dr. Erlinger, succeeded, in 1857, after several years' investigation, in ascertaining the position of the camps of Antony and Augustus, precisely as it was on the eve of the battle of Actium. He found the camp of the latter surrounded by a cincture of redoubts about 5½ miles in extent, which were constructed in stone, and protected by a ditch. In advance of the camp were external works, consisting of several small observation forts, one of them serving as a telegraph for communicating with the fleet. In the ruins of one of these forts was discovered a tablet in steel, on which signals are traced, resembling somewhat those of the aerial telegraphs.

AZGAR TAWARIK, or **TUAREG,** an African tribe of the Berber class, who inhabit the desert country between Ghat on the north and the tracts of the Kelowi Tuaregs on the south, between lat. 21° and 26° N. They were first visited and made known to the European world by the British central African expedition of Barth, Overweg and Richardson. The country in the north is a barren plain, with scarcely any vegetation, and with isolated granite peaks, and few or no animals. The southern portion bordering on the Kelowi Tuarges, is the uninhabited central region of the great desert. The Tuarges do not belong to the negro race. They are fanatical Mohammedans in religion, hating both Pagan and Christian. They are monogamists. They are a warlike artistrocracy divided into five *tiyusi,* or clans, and subdivided into 30 divisions or *fayas,* each of which has a separate chief. See TUAREGS.

AZMARI, the name applied to certain vagrant beggars in Abyssinia, part of whom form the music bands of the Abyssinian army, while the rest exercise their musical voices in the street, especially on religious holidays.

AZO, Porzio, or **AZZO,** or **AZZOLINUS, Portius,** an Italian lawyer: d. about 1230. He lectured on jurisprudence at Bologna with such success that the college could not contain all his auditors, so that he had to take to the public square. His writings on Roman law superseded all those of his predecessors.

AZOBENZENE. See BENZENE.

AZOC COLORS. See COAL TAR COLORS.

AZOIC, a name formerly given to the earliest geological period, before the appearance of life on the earth. It includes the oldest rocks, mostly granites, gneisses and schists, in which there are no traces of organic remains. The term has been variously employed to indicate rocks of Archean and Algonkian age, but has now fallen into disuse in the United States.

AZORES, ą-zōrz, or **WESTERN ISLANDS,** a Portuguese archipelago, in the mid-Atlantic, between lat. 36° 55′ and 39° 55′ N. and between long. 25° 10′ and 31° 16′ W. Stretching over a distance of 400 miles, their nine islands are divided into three distinct groups — Sta. Maria and Saõ Miguel in the southeast; Terceira, Saõ Jorge, Pico, Graciosa and Fayal in the middle, and Flores and Corvo in the northwest. Of these, Flores lies 1,176 miles west of Cape Rocca in Portugal, 1,484 miles southwest of Falmouth and 1,708 miles east-southeast of Halifax. In 1431–53 the Azores were taken possession of by the Portuguese. They were at that time uninhabited; but that they had been visited by the Carthaginians is proved by Punic coins found on Corvo. They seem to have been known to the Arabian geographer Edrisi in the 12th century; and they are marked distinctly on a map of 1351. The Portuguese colonists called the whole group Azores, from *açor* or *azor,* a hawk; and they named two individual islands, Corvo and Saõ Jorge, from Corvi Marini and San Zorze, which, according to a map of 1375, had been previously seen in the western ocean. In 1466 Alfonso V made a life grant of the island of Fayal to his aunt, the Duchess of Burgundy, and from this circumstance many settlers migrated thither from Flanders.

The total area of the group is 922 square miles, and the population about 242,613 (according to official reports before emigration had reduced the aggregate about 8,000). The area, population and maximum altitude of the different islands are as follows: Sta. Maria (38 square miles; 5,880; 1,889 feet); Saõ Miguel (299 square miles; 107,000; 3,854 feet); Terceira (166 square miles; 45,391; 3,435 feet); Graciosa (24 square miles; 8,718); Saõ Jorge (91 square miles; 18,000); Pico (174 square miles; 27,904; 7,613 feet); Fayal (69 square miles; 26,264); Flores (54 square miles; 10,700; 3,087 feet); Corvo (7 square miles; 1,000). The capital is Angra (Angra do Heroismo, population 10,057) in Terceira; but Ponta Delgada, in Saõ Miguel in a larger town, with 16,179 inhabitants. The Azores are of volcanic

origin, and with the exception of Corvo, Flores and Graciosa, are still liable to eruptions and violent earthquakes, the worst of 21 shocks since 1444 having been those of 1591, 1638, 1719 and 1841. Hot mineral springs are numerous; and the baths of Furnas, in Saõ Miguel, are much resorted to by invalids. The coast is generally steep and rugged; the interior abounds in ravines and mountains. Perhaps the greatest want of the group is a good harbor. The Azores are regarded as a province, not a colony, of Portugal, and as belonging to Europe. They comprise three "districts" of the republic and are part of the ecclesiastical province of Lisbon. For their defense they have two line regiments of infantry and two battalions of garrison artillery.

AZOTE, a name formerly given to nitrogen; hence substances containing nitrogen and forming a part of the structure of plants and animals are known as azotized bodies. Such are albumen, fibrine, casein, gelatine, urea, kreatin, etc.

AZOTINE, a substance procured by decomposing wool by the action of steam at 150° C. under a pressure of five atmospheres; the product, afterward dried by evaporation, contains nitrogen completely soluble in water. Azotine is mixed with dried blood for a fertilizer.

AZOTH, an elixir concocted by Paracelsus, which his adherents regarded as a panacea for all spiritual and bodily ills, the "tincture of life."

AZOTURIA, or **AZOTEMIA,** also known as hemoglobinemia, a disease peculiar to horses, of which the chief symptoms are paralysis of the hind legs and a deep darkening of the urine to a coffee color. It usually occurs from too sudden a rest after heavy exertion or labor, without a corresponding change in rations. The disease is often mistaken for spinal meningitis or colic. There are several causes ascribed to it, the most likely theory being that of auto-intoxication. It is believed that in the muscles which have been heavily exerted some disturbance is formed which exerts a toxic action with a too abrupt period of rest, the formation of this substance being assisted by heavy diet. Cases are often fatal. Bleeding is one of the remedies prescribed, which seems at least to give relief. This should be followed by an injection of a normal salt solution, the administration of cathartics, cardiac stimulants, potassium iodide, fomentations of warm water over the loins, electricity to the affected muscles. But far better is prevention; reduction of rations when the animal ceases its regular work, or keeping in pasture.

AZOV, ä-zōf', Russia, a fortified town in the south of Russia, on the Don, seven miles from its mouth. The sand and mud deposited by the river have choked up the port, so that its trade and shipping have dwindled away, and the inhabitants depend mostly on fish-curing. Still an active trade in grain provides an outlet for the southeastern region of Russia. Azov was built nine miles from the site of the ancient Greek colony of Tanaïs; and when, in the 13th century, it was taken possession of by the Genoese, they altered its name to Tana. They were driven out of it by Timur (Tamerlane) in 1392. In 1471 it was taken by the Turks, and in 1696 by Peter the Great; and it was finally ceded to Russia in 1774. In 1855 it was bombarded and greatly damaged by an allied English and French squadron.

AZOV, Sea of (the ancient Palus Mæotis), an arm of the Black Sea, with which it is connected by the Strait of Kertch or Yenikalé. Its greatest length is 226 miles and widest breadth 110 miles, with a superficial area of nearly 15,000 miles. To the northeast it narrows into the Gulf of Taganrog, formerly called the Gulf of Azov. The southwestern shore is formed by the "Spit" or Tongue of Arabat—a strip of land, mud and sand 70 miles long and varying from 1,000 yards to 2½ miles in breadth. Behind or inside this strip, and bordering on the Crimean Peninsula, lies the Sivash or "Putrid Sea," which connects with the Sea of Azov through the narrow Strait of Genichesk. The odor arising from the decayed vegetation of the marshes and a kind of gas-oil is most unpleasant and unhealthy. Whereas the water in the Sea of Azov is not very salty—in the Gulf of Taganrog it is even potable—that of the Sivash contains more salt than perhaps any other sea. This salt is extracted in large quantities (over 1,000,000 tons per annum) and forms an important industry. Shortly before the outbreak of the European War the Russian government began the task of piercing the Perekop Isthmus, which, when completed, will give the Putrid Sea an outlet into the Black Sea and thereby convert the Crimean Peninsula into an island. This may not improbably produce a wholesome change in the atmosphere. In 1835 the Russians constructed a highway along the Spit of Arabat, since when a considerable population and numerous buildings have sprung up. The ruins of an old Tartar fort, captured by the Russians in 1771, still remain at Arabat, a village where the Spit attaches to the Crimea in the south. The Sea of Azov is very shallow and navigation is difficult in parts. The waters abound with fish. Violent storms occur, at times lowering the water level by five feet. There is reason to believe that, thousands of years ago, it was connected with the Caspian Sea. The river Don flows into the Gulf of Taganrog. Of the few scattered islands the largest is Biryutch.

AZPEITIA, ąth-pā'ç-tya, a town in Spain, 18 miles southwest of San Sebastian. A mile from it is the famous convent of Loyola, now converted into a museum and built by the Roman architect, Fontana, in 1683. It includes the tower of the Santa Casa, in which Saint Ignatius of Loyola, the founder of the Society of Jesus, was born in 1491. Here every year in July a great festival is held in his honor, to which pilgrims flock from all quarters. Pop. about 7,000.

AZRAEL, ăz'rā-ĕl, in Mohammedan mythology, the angel of death.

AZREK, the principal stream of Abyssinia, which, after a winding course through Abyssinia and Sennaar, falls into the Nile above Gerri.

AZTEC CLUB, an organization formed to preserve the memories of the war in Mexico, established in Mexico in 1847.

AZTEC CONFEDERACY. The name Aztecs (properly Aztecas) is currently used for all the Nahua (q.v.) tribes in Mexico at the time of the Spanish conquest. It belongs at most only to the seven more closely cognate tribes which occupied the valley of Mexico, and is by some restricted to the one tribe which built Tenochtitlan, or Mexico City, and is so used for convenience here. The name is from the unidentified place (generally assumed as northward) whence they came, Aztlan, variously interpreted as "heron place," "heron-clan place," "white place" and "seacoast"; the best opinion makes it Jalisco or Michoacan, on the west coast of Mexico. Apparently some time from the 9th to the 11th century they invaded the plateau of Anahuac ("waterside," lake district), where tribes of the same stock were already living, and took possession of several commanding points; the chief pueblo being that of the Aztecs or Toltecs at Tollan (now Tula), some 40 miles north of Mexico City, a leading pass from the north into the valley of Mexico. Driven from this by the warfare of the other natives the Aztecs moved south into the valley, and established themselves in the salt marshes where the outlet of lakes Chalco and Xochimilico flows into Lake Tezcuco, or Texcoco, amid which in 1325 (the first absolutely sure date in their history) they built Tenochtitlan, now the City of Mexico. They converted it by dikes and causeways into an island, and gradually made it another Venice, a stone town intersected with canals, the strongest position in Mexico. For more than a century, however, they were tributary to the great pueblo of Azcaputzalco, near them on the western shore of the lake. Gradually they formed a stable military organization and more stable civil society; in 1375 they elected their first "chief of men," war chief and priest in one — Acamapichtli, often styled in books "the founder of the Mexican empire"; and under the fourth chief, Izcoatzin, allied themselves with Tezcuco on the eastern lake shore. The two destroyed Azcaputzalco about 1430 and deported the surviving inhabitants to Tlacopan, near Mexico, which was made tributary to the latter. Tenochtitlan, Tezcuco and Tlacopan then formed a league (the Aztec Confederacy, formerly termed the "Aztec empire"), purely for plunder and tribute, not at all for government or incorporation. The tribute was not only of food and similar supplies, a certain amount of land being cultivated for the benefit of the confederacy, but what was still more coveted, human victims for their gods, to be afterward eaten by themselves; sometimes of warriors for raids on others. The spoil was divided into five parts, Tenochtitlan and Tezcuco each taking two and Tlacopan one. In less than a century of life, this league made some 30 pueblo towns tributary, principally to the east toward the gulf and southeast toward the Isthmus of Tehuantepec — a range of 8,000 or 10,000 square miles out of the 767,097 in the present Mexico. Even this was in no sense a military occupation of the country, much less the foundation of a state. Within a few dozen miles were great independent pueblos such as Cholula and Tlascala, the latter a strong and warlike settlement of some 30,000 people, who waged war to the knife with the Aztec Confederacy, defeated their plundering assaults again and again, and aided other pueblos in resistance. Montezuma (q.v.), who acceded 1502, was heavily defeated by them and by the towns in Michoacan, but won success on the gulf coast; and when the Spaniards came, the southern Mexican Peninsula was a mass of seething savage hatreds and feuds, no two tribes of the natives having any community of feeling or interest that could prompt them to unite with one another rather than with the foreigner. See CORTÉS; MEXICO; MONTEZUMA.

The Aztec tribe was divided into 20 clans or *calpullis*, each clan occupying several contiguous communal houses, each of which held several hundred persons; besides a clan office building where assemblies were held and strangers entertained. It was governed by an elected council, with a civil and a military head as in Rome, the latter being also constable. Each clan had its special rites, priests and temple. It was divided into four phratries, each having among other duties that of exacting compensation for murders, and each ward had its own precinct, constituting four wards or quarters of the town, its arsenal and its captain. These captains were called "darthouse-man," "man-slasher," "bloodshedder" and "chief of the eagle and cactus," the latter being chief executioner, and not eligible for the chieftainship of the tribe. The supreme government of the Aztecs was by a council of 20, one from each clan, who must not be a sachem, but a member of the clan council; he was called the "speaker," and the tribal council the "speech-place" (parliament, literally). It met every 10 days at least, and oftener if called together. Once in 80 days there was a special session attended by all the leading clan and phratry officials and priests, to reconsider unpopular decisions. The tribe, too, had a dual executive, civil and religious: a sachem who was civil magistrate and chief judge; and a war chief called "chief of men," and who exercised also some priestly functions, though there was a high priest. He was originally chief only of the Aztecs; but about 1430 (probably on occasion of the destruction of Azcaputzalco), was made chief of the confederate army. He was elected by the tribal council and the clan war chiefs and leading priests, and could be deposed by them. His official residence was in the tribal office. From the time of the first chief, Acamapichtli, the office remained in a single family, like the old Aryan kingship.

The social and religious organization was a peculiar mixture of the lowest barbarism and the beginnings of civilization. There was no private property in land or dwellings; each man could keep a garden plot for his use, but it was his no longer than he used it. Family life had emerged from savage promiscuity; descent was reckoned in the male line, marital infidelity was punished, and remaining unmarried was not permitted except by special dispensation,— contumacy being punished by being made an outcast, a serf if a man and a prostitute if a woman. Slavery had thus began in a small way; but the habitual use of prisoners of war as slaves had not, it being preferable to sacrifice and eat them. Agriculture was still primitive; but irrigation was practised to some extent, and horticulture was beginning to develop. The roads were only narrow trails; but they facilitated collection of tribute, and

served military and trading purposes as well. The houses were generally of adobe brick, but many of the great pueblos were of stone, so that the towns looked like castellated cities. There were tessellated marble floors, finely worked and colored tapestries, and beautiful feather-work, vases, goblets and censers of fine marbles and precious metals exquisitely wrought. There were regular weekly markets, which, though trade was by barter, indicated a large development of personal property and of superfluity above subsistence. There were elaborate pleasure-grounds, menageries, and aviaries, baths and fountains and pleasure performances of dramas and singers, acrobats and jugglers. Yet the people were cannibals, and their religion was of the most hideous character, albeit with regularly organized priesthood and temples and altars. Consule Biart, L., 'The Aztecs: Their History, Manners and Customs' (Chicago 1905); Joyce, T. A., 'Mexican Archæology' (New York and London 1914); Taft, G. E., 'Chimalman' (New York 1916).

MARRION WILCOX.

AZTEC TREASURE-HOUSE, The, a romance by Thomas A. Janvier. It purports to be a narration of the thrilling adventures of a certain Prof. Thomas Palgrave, Ph.D., an archæologist who goes to Mexico to discover, if possible, remains of the early Aztec civilization.

AZTECS. See AZTEC CONFEDERACY.

AZUAY, ä-thoo-ī', a province in the mountainous southwestern part of Ecuador, with an area of about 11,150 square miles. The cinchona tree is found here in abundance and the high plains near the Peruvian boundary are well adapted to agriculture. The inhabitants of this province as a whole, including the large Indian element, have long been known for their skill in weaving, lace-making and the potter's art. The provincial capital, Cuenca, is locally famous as a centre of literary activity in the republic. Azuay's climate, throughout the regions that have an elevation of 8,000 to 9,000 feet above sea-level, is excellent. Pop. about 132,400. See articles CUENCA and ECUADOR.

AZULAI, ä'zoo-lī, **Hayim David,** 18th century Jewish bibliographer: b. Jerusalem. His life was mainly spent at Leghorn. Of his numerous works, the best known is 'Shem-ha-Gedôlim' (the names of the great), a bibliography containing the names of over 1,300 Jewish authors and more than 2,200 of their works.

AZULEJO, ä'thōō-lā'hō, a word derived from the Spanish word «azul,» meaning blue, and applied to a kind of glazed tile manufactured by the Moors in Spain and used in wall decoration. The art of making these tiles was inherited by the Spaniards, some of the patterns or designs used to-day being the same as those employed by the Moors.

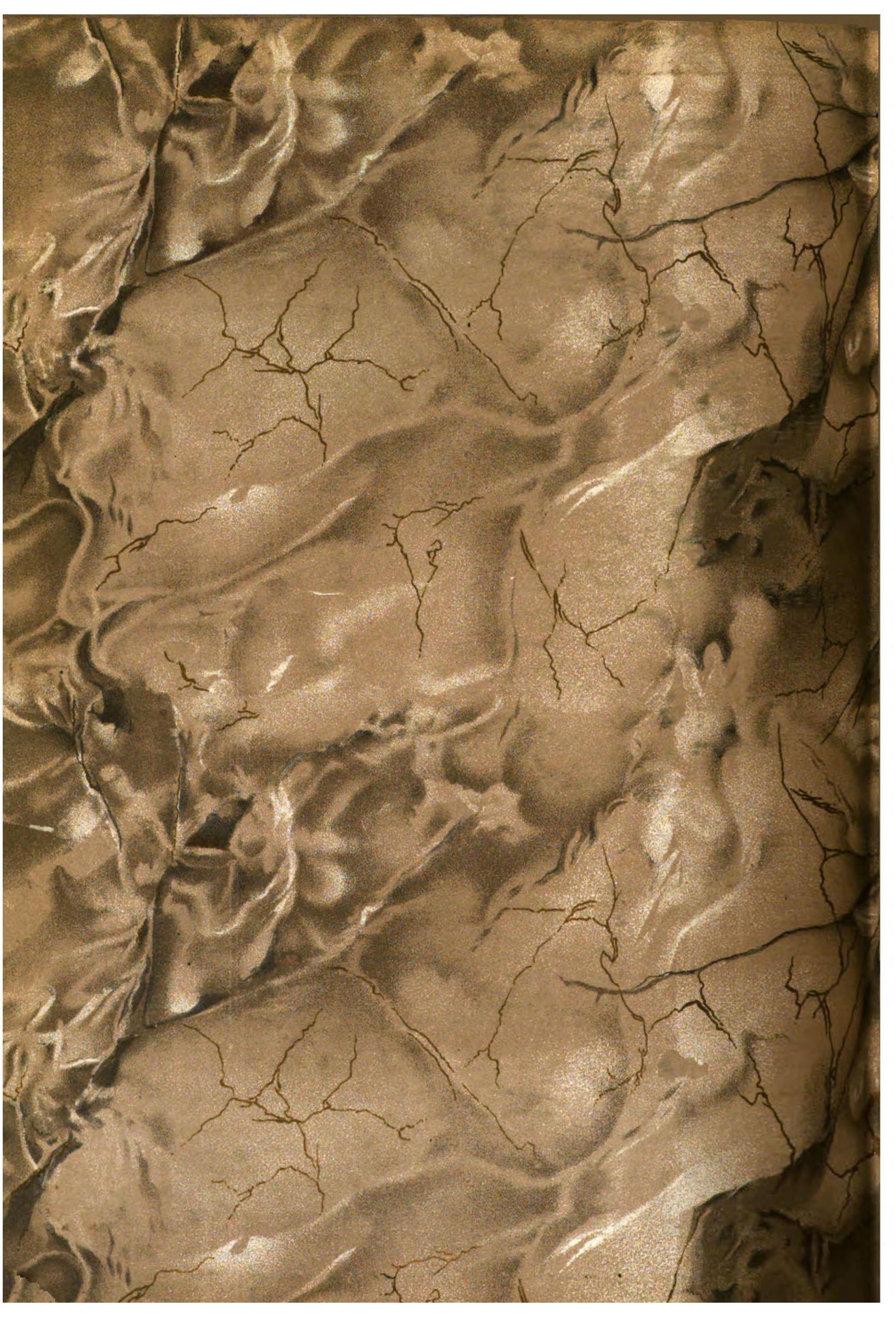
AZUNI, äd-zoo'ne, **Domenico Alberto,** Italian jurist: b. Sassari, Sardinia, 1749; d. 23 Jan. 1827. He became judge of the tribunal of commerce at Nice and in 1795 published a work in which he endeavored to reduce maritime laws to fixed principles and which appeared in French in 1805, under the title of 'Droit Maritime de l'Europe.' Napoleon appointed him one of the commissioners for compiling the new commercial code.

AZURE, the heraldic term for the color blue, represented in engraving by horizontal lines.

AZURINE, a species of European roach, blue in color.

AZURITE, one of the commonest ores of copper, a basic copper carbonate, having the formula $2CuCO_3.Cu(OH)_2$. Its hardness is 3.5 to 4 and specific gravity about 3.8. It is a mineral of rare beauty, its usual color being a rich Prussian to azure blue, from which fact its name is derived. Its color is, however, often so dark as to appear nearly black, this frequently being true of its crystallized forms. These are very varied and complex and belong to the monoclinic system. They are often transparent and have a most brilliant vitreous to adamantine lustre and are beautifully striated, while their frequent association with bright green malachite adds much to the beauty of the specimens. These two minerals sometimes occur in stalactitic forms, the one encircling the other. Such specimens have been extensively cut and polished in cross sections and worked up for various ornamental purposes. The finest material of this kind comes from Morenci, Ariz., this locality also yielding exceptionally fine crystallized specimens rivaling those from its other most celebrated localities, Bisbee, Ariz., Siberia, and Chessy, France. Its occurrence at the latter locality, which has been famous for many years, has led to the frequent use of the name «chessylite» for azurite, especially in Europe. Many other localities yield choice specimens, the copper mines of the western portion of the United States being especially celebrated. In New Mexico curious pseudomorphs of native copper after azurite «balls» occur in large numbers, while pseudomorphs of malachite after azurite are very common.

AZYMITES (Lat. *azymus,* unleavened), a term applied by the Eastern to the Western Church because the latter used unleavened bread in the administration of the Eucharist. In the Western Church the point has never been regarded as of vital importance. The matter was considered at the Council of Florence (1439). The Western Church called the Greek schismatics Pro-zymites.

AZZARKAL, ạz'ạr-käl', Arabian mathematician and astronomer: b. Cordova in the first half of the 11th century. He was royal astronomer of Al-Mamoun, King of Toledo. He invented divers instruments for making observations, constructed a water-clock of extraordinary dimensions, as well as a planisphere and an astrolabe, upon new principles.

AZZUBEYDI, ạ'zoo-bī'dē, **Mohammed Ibn el Hasan,** Arabian lexicographer: b. Seville 927; d. 982. He was cadi of Seville and preceptor of Hischeam, son and heir of the Sultan. He wrote an abridgment of the great biography of the Spanish grammarians, by Khalil; a treatise on grammar and a work upon the character of the syntax of the Arabic language.